AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 16, NO. 19. WEEKLY. | NEW YORK, THURSDAY, MAY 11, 1893. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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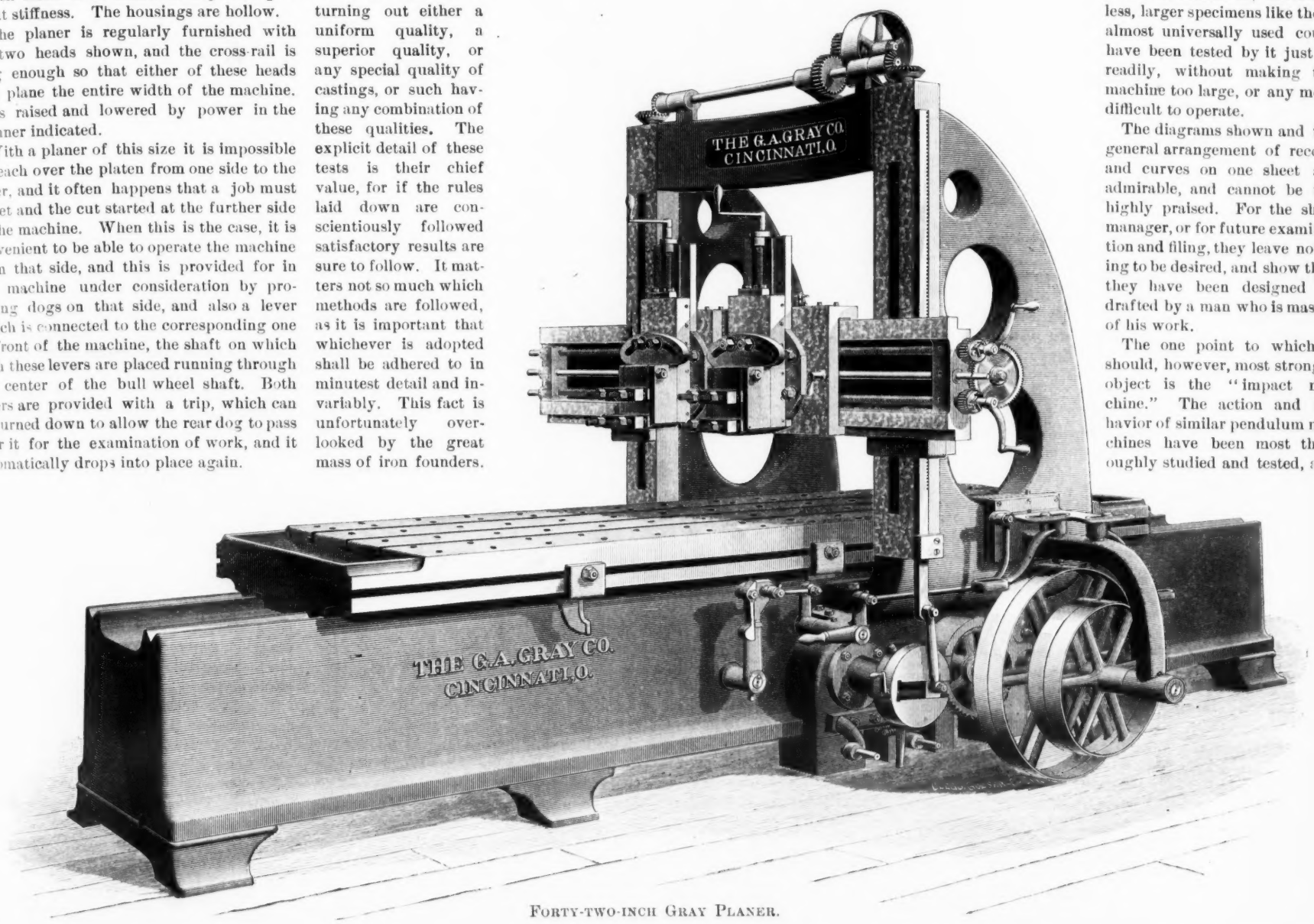
ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Forty-two-inch Gray Planer.

We present on this page an engraving of the latest design of "Gray" planer. The general design and proportions of the tool are clearly indicated by the engraving, which shows that the bed, platen, housings and cross-rail are proportioned in accordance with the modern ideas and requirements in such tools. A solid web extends from one side of the bed to the other under the platen which latter is of sufficient depth to give great stiffness. The housings are hollow.

The planer is regularly furnished with the two heads shown, and the cross-rail is long enough so that either of these heads will plane the entire width of the machine. It is raised and lowered by power in the manner indicated.

With a planer of this size it is impossible to reach over the platen from one side to the other, and it often happens that a job must be set and the cut started at the further side of the machine. When this is the case, it is convenient to be able to operate the machine from that side, and this is provided for in the machine under consideration by providing dogs on that side, and also a lever which is connected to the corresponding one in front of the machine, the shaft on which both these levers are placed running through the center of the bull wheel shaft. Both levers are provided with a trip, which can be turned down to allow the rear dog to pass over it for the examination of work, and it automatically drops into place again.



FORTY-TWO-INCH GRAY PLANER.

Since both heads can be moved on the rail, and both vertical slides also moved from the rear side of the machine, it is entirely practicable to set the work and start a cut from that side without going around the machine.

The Vs are automatically oiled by double conical rollers placed within pockets in the bed, and there is thorough provision for oiling every part of the machine.

A high belt speed enables the belts to be shifted quickly and easily. The first pinion in the train of gearing is of rawhide, insuring quiet running, and things are so proportioned that the driving power is ample and the reversing quiet and accurate. With 20 feet cutting speed the return speed of the platen is 80 feet, or four to one. The planer is made by The G. A. Gray Co., Cincinnati, Ohio.

Keep's Tests for Cast-iron.

BY GUS. C. HENNING, M. E.

Under this title has appeared in the AMERICAN MACHINIST of Jan. 5, 12, 19 and Feb. 9 a complete description of a new method of routine tests of cast-iron, which are so simple, correct and economical that they, or something very much like them, deserve to be introduced in every foundry which is desirous of turning out either a uniform quality, a superior quality, or any special quality of castings, or such having any combination of these qualities. The explicit detail of these tests is their chief value, for if the rules laid down are conscientiously followed satisfactory results are sure to follow. It matters not so much which methods are followed, as it is important that whichever is adopted shall be adhered to in minutest detail and invariably. This fact is unfortunately overlooked by the great mass of iron founders. Mr. Keep was one of the few to point out this very essential necessity in testing, and there can be no doubt that his results in a practical and economical way are most satisfactory and valuable. It is very much to be regretted that the great mass of engineers and inspectors do not give sufficient weight to uniform methods, absolutely refuse to learn that these are of much greater importance than the great refinements of measurement in some points, really not essential, and prefer to follow their own pet methods rather than to learn from the work of others.

With all the respect I have for Mr. Keep's precision of methods, I must express my regret that in his adopted standards he has departed from common European and domestic dimensions of test pieces in such a striking manner as to make his work totally incomparable with that of such renowned experimenters as Bauschinger, Martens, Kirsch, Unwin, Barba and others. I am almost inclined to believe that the records of the best equipped laboratories were not at Mr. Keep's command, and, therefore, he adopted what suited his purposes admirably, but makes his very valuable work stand by itself.

I do not deny that any one following his methods carefully will obtain equally good practical results, but what I regret and bewail is that had he adopted other standards his work and results would have been precisely as valuable and practical, and at the same time could be placed side by side, and compared with the very best work that has ever been done in testing materials, which unfortunately cannot now be done. However, as he has not yet introduced his patterns and standards in too many places, it is to be hoped that he will adopt those of other investigators, and without impairing his work or changing his methods in the slightest detail.

Never before has a test bar $\frac{1}{2}$ inch square and 12 inches long been used in any very correct or valuable work, nor strips 1 foot by $\frac{1}{10}$ inch by 12 inches. These are undoubtedly most useful for stove work, but there can be little doubt that bars or strips of larger sizes would have answered the purpose equally well. I state this in spite of Mr Keep's statement that these small bars "show changes in material better than larger ones," as this is not by any means the experience generally obtained.

His dead load machine undoubtedly is a very convenient and sufficiently accurate machine for the object of the tests or the men that handle it; nevertheless, larger specimens like those almost universally used could have been tested by it just as readily, without making the machine too large, or any more difficult to operate.

The diagrams shown and the general arrangement of record and curves on one sheet are admirable, and cannot be too highly praised. For the shop manager, or for future examination and filing, they leave nothing to be desired, and show that they have been designed or drafted by a man who is master of his work.

The one point to which I should, however, most strongly object is the "impact machine." The action and behavior of similar pendulum machines have been most thoroughly studied and tested, and they have all of them been thrown aside as unreliable. They are not uniform in their behavior, being subject to variation due to vibration or tremor, to elastic recoil of the striking weight, and to unsatisfactory action of the supporting pivot or pin. If the striking block was perfectly elastic and unchangeable, or perfectly inelastic, there might not be so much objection, but these properties being constantly variable and indefinite, or at least indeterminate, errors are introduced which cannot be guarded against, corrected, or verified. Many years of closest study and experimenting have demonstrated to Prof. Martens, director of the celebrated testing laboratory at the Polytechnic school at Charlottenburg, Berlin, that the only safe and accurate impact machine is a drop test machine, consisting of a weight falling

between guides and striking on a massive block or anvil. This apparatus was carefully tested by a number of investigators, and their conclusions agree closely with his. It was fully described in the official reports of his laboratory, and the latest and most striking results of his research with it were described at some length in the *Engineering and Mining Journal* in January, 1892. It is greatly to be regretted that Mr. Keep should have introduced one more form of testing machine, when another one which has given such eminently satisfactory results would have answered his purposes better, regardless of the size of specimen. The height of fall of weight or mass of weight could have been varied at will and with perfect accuracy, and the certainty of striking the test piece invariably in the same manner would have added materially to the accuracy of his tests.

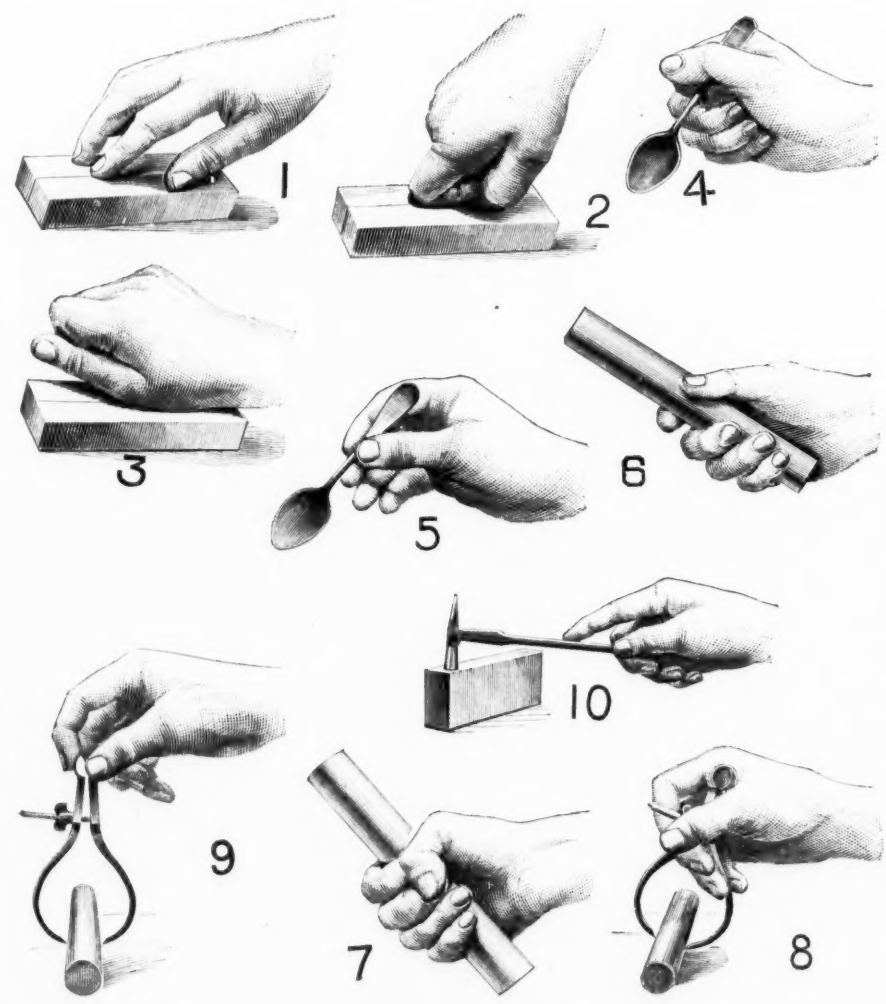
I do not wish to say that his apparatus does not give results satisfactory for his purposes, but a more reliable and accurate machine would have answered his purposes equally well, and answered for the finest work at the same time. In such a machine all variations and errors have been carefully catalogued, determined and measured, and no difficulties are encountered in its use. Moreover the drop test machine could have been provided with the same recording device as shown, and in an almost identical manner.

Manual Sensibility and Mechanical Differentiation.

BY JAMES ARTHUR.

The relation existing between the method of grasping tools and implements by the hand and its sensitiveness has attracted my attention for many years. Later, I have been led to associate this with mechanical differentiation, meaning by this, the capacity to form a clear mental picture of differences in objects which are so nearly alike that the sense of sight cannot distinguish between them. Under this head come deviations from uniformity in curves, circles, spheres, planes, etc., too small to be seen. The following elementary observations are made from the mechanical standpoint, and refer to information obtained by manual contact. I incline to the opinion that more important mechanical perceptions reach the mind through the hand than is generally supposed, and the ten illustrations given are intended as the merest beginning in drawing attention to a wide question where hundreds would be necessary. They are copied from photographs taken from the right hands of three persons, and as they are all first-class hands, the more awkward grips are imitations, and do not look nearly so bad as many I have observed, but they will be sufficient to indicate my meaning.

Having freely discussed the matter with friends, no claim to originality is made, and therefore I do not attempt to determine my share. In No. 1 the points of the fingers are being used to feel if the two pieces are even at the joint—that is, if their faces lie in the same plane. The side of the forefinger is used for the same purpose in 2, and the ball of the thumb in 3. An immense number, like 2 and 3, including the palm, the side of the thumb, the knuckles, etc , are very common in feeling the condition of surfaces as to roughness, smoothness, dryness, dampness, stickiness, temperature, etc. Most persons would consider 4 simply awkward, and 5 quite proper, but I hope to show that there is more than this indicated by such holds. Hammers and other tools having straight handles offer a rich field for observation, but I can only find room for two, as examples 6 and 7. The extremes in the use of calipers and tools of delicacy are indicated in 8 and 9, but they will give a poor idea of the variety. I consider 10 an example of the most sensitive hold. Taking extremes 1 and 3, 7 and 10, 8 and 9, an indefinite number will be found between them, varying largely with the weight of the tools, thickness of handles, force to be applied, and other variations, but all my observations lead to the theory that sensitiveness of touch is greatest at *finger and thumb points;* that hands with the greatest tendency to *finger point* contact are superior; and that, in comparing hands, they become inferior in proportion as they depend on *side contact*, the farther from the points, or tips of fingers, the worse. In other words, the hand is lower, as it tends to grasp *all in a mass*, and higher, as it tends to *individualize* fingers and thumbs. (To avoid repetition, I shall leave out the word thumbs from this forward, but they are always to be understood along with fingers.) It is lower as it grasps like a monkey, or tree toad, and higher as the extremities come into use. Indeed, I have satisfied myself that the evolution of the human hand means differentiating the action of its digits and an increase in their sensitiveness. While the greater the power to be applied, the nearer the grasp will approach 7, and the less 10; still, the tendency of the superior hand is to have one or more finger points in contact. Those points appear to be most delicate, and to act as the governors in the direction and application of force; they are, as it were, the sensitive electric contacts which bring the brain nearest to the object. They bring the person much closer to his environment, the mind is better informed as to what is going on outside, and is, therefore, more in control.



This prepares the way for my second point—that the clumsy-fisted grasp (4 and 7) is deficient in measuring the force applied For example, the man who grasps like 7 cannot determine how much force he is using, and will twist off the head of a set-screw, and tell you he just "took it up snug"; or he will, as in 8, make a shaft which should be one inch, $1\frac{1}{64}''$, and state that he left it a "little tight in the calipers"; while another (9) will leave the shaft within $\frac{1}{1000}$, and (6) use the set-screw for years. With the *all in-a-lump* grasp (7 and 8), he is groping in mechanical darkness, has only a dim mental perception of the qualities of the objects operated on, and must depend on the eye for guidance, which can only come through the nerves of feeling. This question of measuring the amount of force applied would require much fuller treatment than there is space for here, so I will only touch on it.

One of the most marked peculiarities of men taking a bad hold is their tendency to smash tools by using them for purposes not intended by the makers, and to break the work operated on, where that is possible. It is often worth the value of a tap to see their genuine surprise as they hold its pieces in their thick-skinned, obtuse fingers. These are the men who are disgusted with our modern "jim-crack" tools, yet these very tools in proper hands produce wonderful results. Those with a better hand contact work towards the ideal of reducing force as near as possible to that necessary at the cutting edge of the tool, while those of the clumsy grip, badly connected with the external world, waste power without knowing it. I think we have here an explanation of the earnest and extreme efforts of some workmen and the small results, while others with little apparent effort produce much better work in larger quantities. The former reminds me of the remark of a literary man, who had earnestly watched a workman for some time: "He seems to make a great many vain attempts."

In earlier years I tended to blame these men with carelessness only, but later I find that many of them are earnest in their efforts. They are a little like the near-sighted shying horse—they do not clearly know what is going on. When we put concave spectacles on the horse, and he becomes aware just where he stands in relation to external objects, his motions become precise and rational, but, unfortunately, we have not yet invented touch accumulators for the deficient human hand.

My third point is, that the clumsy-fisted grip and obtuse mental perceptions in mechanics are associated. After what has been written above, it is hardly necessary to offer much in support of this. Knowledge of external objects must reach the individual from without, and if the nerve telegraphs are poor conductors, then the knowledge must be hazy and indistinct; and since the highest and most differentiated mechanical perceptions must reach the brain and consciousness through the nerves of feeling, then, if these nerves are dull, so is the brain. In some way a person can *think* the action of a lever or screw, but the obtuse handed apparently cannot, for one avenue of communication is partially closed. The examples of this are beyond computation. One of the commonest fields for observing the deficiency is the fastening of work on machines with straps, bolts, wedges, etc. Here we have endless combinations of the lever and screw, generally concealed, and our deficient in mechanics has a wonderful knack of screwing down the long end of the lever last. When the piece being fastened constitutes a lever by touching the machine platen or chuck at a point near one side, he is just as likely to screw down the opposite side last, and when the first bolt fastened pulls up the lips of the T groove in the machine, he is as much bewildered as a darkey struck with a brick. Straps with one bolt in the center constitute a lever, and it is often painful to see the attempts to fasten a piece with the blocking pieces close up to the bolt, and the work under the long end of the strap. In putting together a machine, which has been correctly fitted originally, strains sufficient to spring or break heavy parts of the framing can be easily set up by tightening the wrong bolts last. Another extreme case is the use of the hammer on long pieces held by one end in the chuck, the strongest chuck jaws and the heaviest lathe spindles being often injured by ordinary blows of a hand hammer. In these and others like them, the power used by the wrench or the hammer is not *correctly estimated*, and further, it is applied very often at the place where it does most mischief.

Now, it will not do to say that these examples of ignorance simply indicate that the man is not a trained mechanic, for I am writing about regular workmen with experience. Not only so, but I am using observations covering a wide field. Nor will it do to brush the matter aside by saying that these examples are too simple to be considered, for they are not, in practice, simple to any but men well endowed. Take one more example (just as simple as the others): A machine is taking a moderate cut, only one-half of what it will cut under favorable circumstances, yet it is being strained to its greatest capacity, and a good workman is puzzled, for he has the work fastened securely, and the tool grasp as tight as it will stand; still the machine labors heavily, and the cut chatters. Very simple, is it? Yes, but only if the workman had the good luck to draw a head and hands in the lottery of birth. Simple; probably it is—to the visitor who is quietly walking past the machine without slacking his pace. What I am coming to is the statement that men with deficient touch *cannot think power*, and are mechanically blind to the action of levers and wedges, which are quite evident (and almost instinctive) to those better endowed with hands. Of course the head is the important thing, but I have satisfied myself that the hand with sensitive touch is more important than has heretofore been suspected. It is one indispensable possession of the high-class mechanic.

It might be supposed that the common expressions, "He has good hands, but no head," and "He has a great head, but could not make a corn crib," are against my theory, but the "head" in both these sayings refers to *invention* and *executive* ability.

It might be well to state that I have nothing to say as to whether finger points *ought* to be the most sensitive part of the hand; I only record my observations that the man with delicate touch in points is the only one I have ever found capable of the highest mechanical operations, and that those depending on side contact have to be kept at the rougher work. Further, no attempt is here made to teach any one how he ought to hold a given tool, as I think great latitude ought to be allowed the individual, so long as he does not wrap his fingers around, *all in a bunch*. If he does this, I unhesitatingly pronounce his hands inferior. No connection between stoutness or slimness and sensitiveness has been apparent to me, the chubby hand being often very high, while the slim, nervous-looking hand, with tapering fingers, may be low, or the reverse; more than this, the big-jointed hand, with spatula-pointed fingers, may belong to the highest class, so I take little notice of the *appearance* of the hand, and depend on actual test. The last point I shall notice at

present is the tendency of the inferior hand to become coarse and callous-skinned by rough work, its obtuseness causing it to be abused, while the superior hand, doing exactly the same kind of work, will keep elastic and sensitive on account of its owner applying force much more cautiously, economically and directly.

Summarizing my theory, it stands somewhat as follows:

1st. Manual sensibility is found principally at finger and thumb points.

2d. Side contact is deficient for directing and measuring force, the farther from finger points, the worse.

3d. The deficient side contact indicates the obtuse brain for mechanical differentiation beyond the range of sight. From these three I conclude finally that the highest manual art in mechanics is only possible with finger point contact.

While I do not have any theory to offer beyond the above, at present, there is a wide field outside the mechanical view, and t could do no harm to partially indicate it. An inventor, who is also a physiologist, and who has had a very great variety of work done in perfecting his many inventions, and has, therefore, come in contact with workmen, directly, a great deal, states to me that the obtuse fingered men are less honest and trustworthy than those with sensitive hands. When to this is added the statement from one of the latest works on criminology, substantially, that criminals are less sensitive in the skin than normal persons, and suffer less pain in being tattooed,* we have a serious and important phase of the question presented, but I simply note these opinions of others here.

Improved Lincoln Milling Machine—Duplex Milling Machine.

We present with this engravings of two milling machines which have been recently brought out by the Garvin Machine Co., of New York City. The first of the engravings shows the Lincoln machine. It is heavier than such machines are usually built, and has some special features of construction.

The bed is 66″ long, 15″ wide and 10″ deep, and is mounted on a stand with oil pan, tank and pump as in screw machine practice. The table is of very ample proportions, has a bearing in cross slide of more than half its length, two T-slots, and is powerfully fed its entire length by a large bronze screw running in oil, and engaging with a coarse pitch spiral rack, cut on the underside of the platen its full length.

The spindle is of steel, with tapered front bearing running in a solid bronze box, with hardened and ground anti-friction washers to take the thrust. It is also provided with self-oiling facilities and means of adjustment for wear. The front end has a tapered hole to receive the arbor, which is held in place and removed by a stud bolt passing through the spindle, and operated from rear end.

The cone is of ample proportions, and swings in a frame so arranged as to readily adjust itself to the various positions of the spindle. The feed cones are arranged to keep the belt always at the proper tension, insuring a steady positive motion to the table.

The foot-stock is cast solid with its base and is readily adjusted to any part of the bed in line with spindle.

Cone has four steps for 3″ belt, the largest being 12″ diameter. Front spindle bearing is 3⅜″x5″; vertical adjustment over table from 2¾″ lowest to 10″ highest position; table, 9½″x40″; adjustment in line with the spindle 12″; length of feed, 40″; bearing in cross slide, 31½″; weight complete, 3,000 pounds.

In the duplex machine the same bed, and, in fact, all the leading dimensions of the mahine are the same. The two spindlesc are separately driven, and can be adjusted vertically either separately or together as may be desired.

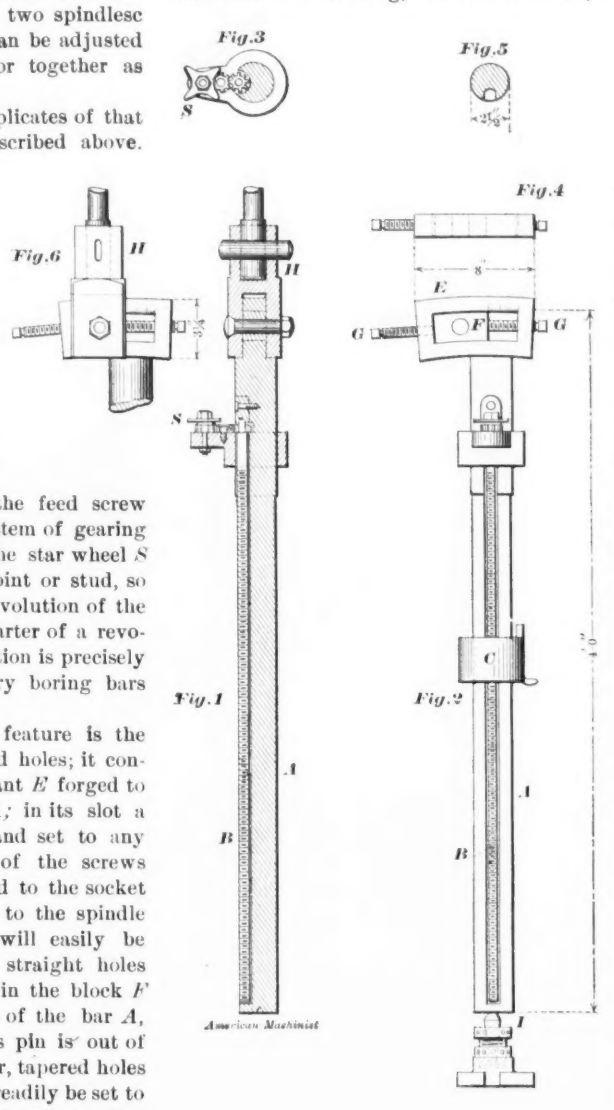
The heads are alike and duplicates of that on the Lincoln machine described above. They are adjusted along the bed by screws with hand-wheels conveniently placed. The machine weighs 3,350 pounds.

New Boring Bar.

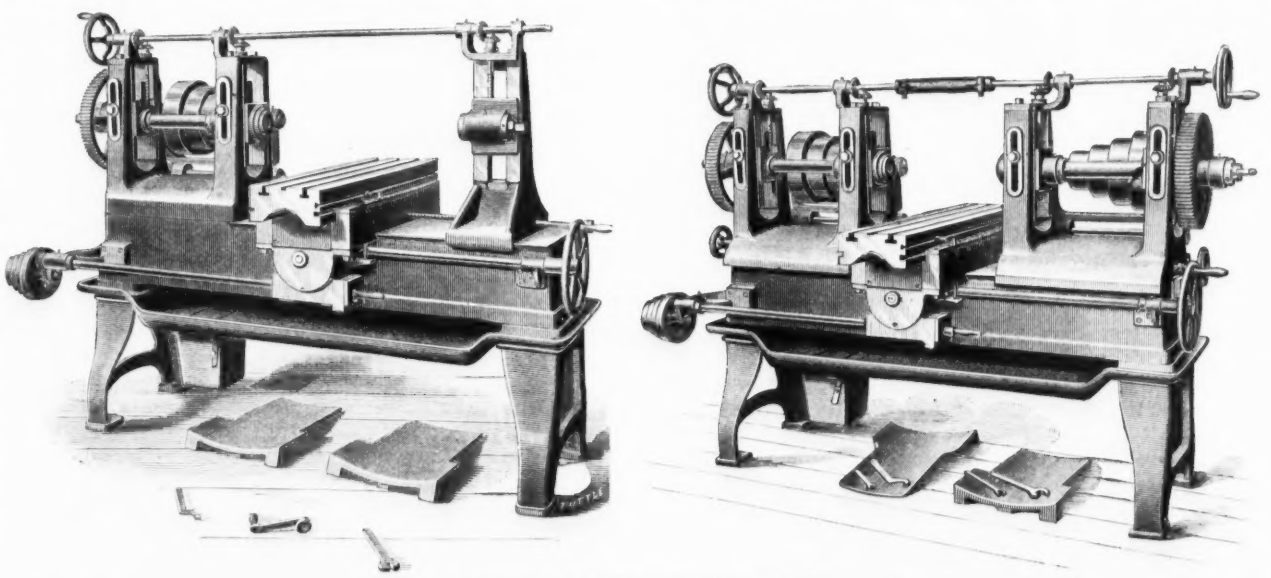
With this we give illustrations of a new boring bar designed to bore straight and tapered holes. It consists of a bar *A*, a cutter head *C* tapped to receive the feed screw *B* which is actuated by a system of gearing attached to its upper end, the star wheel *S* engaging with some fixed point or stud, so that in this case for every revolution of the bar, the screw makes one-quarter of a revolution. So far the construction is precisely the same as that of ordinary boring bars with star feeds.

The new and principal feature is the attachment for boring tapered holes; it consists of a short slotted quadrant *E* forged to the upper end of the bar *A;* in its slot a block *F* is accurately fitted and set to any desired position by means of the screws *G G*. This block is attached to the socket *H*, the latter being fastened to the spindle of a drilling machine. It will easily be seen that the bar will bore straight holes when the center of the pin in the block *F* is in line with the center line of the bar *A*, and when the center of this pin is out of line with the center of the bar, tapered holes will be bored. The bar can readily be set to suit any taper ranging from $\frac{1}{32}$ inch per foot to 1 inch per foot by means of the scale on the upper edge of the slot; this scale is laid off to correspond to the length of the bar, so that accuracy is secured. The lower end of the bar rests on the center *I*, which can be raised or lowered so as to increase or diminish the depth of cut in boring tapered holes.

This bar was specially made for boring tapered holes in propeller wheels in a shop where other tools were not available for the purpose, and we are informed that the results in regard to accuracy and speed were very satisfactory. This design of bar is patented and made by Ava Tatem, of the Twin City Iron Works, Norfolk, Va.

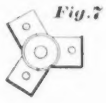


New Boring Bar.



Improved Lincoln and Duplex Milling Machines.

The "Campania," the new Cunard steamship, in her maiden trip to New York is said to have behaved admirably, though she was not crowded in a way to develop her speed She is fitted with two sets of triple-expansion engines, each set having five cylinders—two high-pressure, two low-pressure and one intermediate. The high-pressure cylinders are 37 inches, the low pressure 98 inches and the intermediate cylinders 79 inches diameter, stroke 69 inches. The crank-shafts are 26 inches diameter. There are twelve double-ended boilers, each 18 feet diameter and 17 feet long, with four furnaces, in each end. There are also two other boilers, one 18 feet diameter and 11 feet long, the other 10 feet by 10 feet.



Professor Dr. Poleck recently read a paper before the Silesian Society on a new alloy of wolfram and iron, which is reported in *Stahl und Eisen*. The specimen given came from the Biermann Works, in Hanover, and was richer in wolfram. These crystals were hexagonal, with a silvery lustre, very heavy, and had the hardness of corundum. The specific weight of the general mass was 12.92 to 13.04.

Strength of Various Materials—Extracts from Kirkaldy's Tests—I.*

By William Kent.

The tables given in Engineers' Pocket-books and other works of reference of strength of various materials are frequently misleading on account of their giving average figures without specifying the number of tests made, or the maximum and minimum strength found in the same lot. Thus, Nystrom's Pocket-book, edition of 1891, page 314, gives for the cohesive strength per square inch, at which they "will just tear asunder," the following figures for the metals named: cast-steel, 134,250; iron sheet parallel to rolling, 40,000; at right angles to rolling, 34,400; cast-iron, good quality, 45,000; inferior, 18,000. The figure for cast steel can be true only of some high carbon steel, and is more than double the usual strength of steel boiler plate; the figure for sheet iron could have been obtained only from exceptionally bad pieces; 45,000 for good cast-iron has been obtained so rarely that it may be considered an extraordinary value for the best charcoal car-wheel iron, and 18,000, so far from being inferior, is above the usual average.

The recent publication in a book by W. G. Kirkaldy, of the results of many thousand tests, made during a quarter of a century by his father, David Kirkaldy, has made an important contribution to our knowledge concerning the range of variation in strength of numerous materials. It has appeared to the writer that a study of Mr. Kirkaldy's results and a condensed abstract from his tables, if published in convenient form, would be of service as tables of reference which might supersede those hitherto published in the pocket-books. He has therefore undertaken the compilation which follows:

The figures for tensile and compressive strength, or, as Kirkaldy calls them, pulling and thrusting stress, are given in pounds per square inch of original section, and for bending strength in pounds of actual stress or pounds per B D^2 (breadth × square of depth) for length of 36 inches between supports. The contraction of area is given as a percentage of the original area, and the extension as a percentage in a length of 10 inches, except when otherwise stated. The abbreviations T. S., E. L., Contr., and Ext., are used for the sake of brevity, to represent tensile strength, elastic limit, contraction of area and elongation, respectively.

Cast-iron.—Strength of cast-iron used in the Battersea Bridge: tensile strength, 44 tests, 15,468 to 28,740 pounds; 17 of these were unsound, the strength ranging from 15,468 to 24,357 pounds. The average strength of all the specimens was 23,805 pounds.

Thrusting stress, specimens 2 inches long, 1.34 to 1.5 diameter; 43 specimens, all sound, 94,352 to 131,912; one specimen, unsound, 93,759; average of all, 113,825.

Bending stress, distance between supports, 36 inches. Bars about 1 inch wide by 2 inches deep, cast on edge. Ultimate stress 2,876 to 3,854; stress per B D^2 = 725 to 892; average 820. Average modulus of rupture, R, = stress per BD^2 × length, = 29,520. Ultimate deflection, .29 to .40 inch; average .34 inch.

*Criminology: McDonald; Funk & Wagnalls.

*Strength and Properties of Materials with Description of System of Testing. By W. G. Kirkaldy. D. Van Nostrand Company, New York.

Other tests of cast-iron, 460 tests, 16 lots from various sources, gave results with total range as follows: Pulling stress, 12,688 to 33,616 pounds; thrusting stress, 66,363 to 175,950 pounds; bending stress, per $B D^2$, 505 to 1,128 pounds; modulus of rupture, R, 18,180 to 40,608. Ultimate deflection, .21 to .45 inch.

The specimen which was the highest in thrusting stress was also the highest in bending, and showed the greatest deflection, but its tensile strength was only 26,502.

The specimen with the highest tensile strength had a thrusting stress of 143,939, and a bending strength, per $B D^2$, of 979 pounds with 0.41 deflection. The specimen lowest in T. S. was also lowest in thrusting and bending, but gave .38 deflection. The specimen which gave .21 deflection had T. S., 19,188; thrusting, 104,281, and bending, 561.

The mean results of each of the 16 lots ranged as follows: Pulling, 21,711 to 29,472 pounds per square inch; thrusting, 105,918 to 138,054 pounds per square inch; bending, 683 to 849 pounds; deflection, .26 to .39 inch.

Iron Castings.—69 tests; tensile strength, 10,416 to 31,652; thrusting stress, ultimate per square inch, 53,502 to 132,031.

Channel Irons.—Tests of 18 pieces cut from channel irons. The ultimate tensile stress ranged from 40,693 to 53,141 pounds per square inch; contraction of area from 3.9 to 32.5 per cent.; extension in 10 inches from 2.1 to 22.5 per cent. The fractures ranged all the way from 100 per cent. fibrous to 100 per cent. crystalline. The highest T. S., 53,141, with 8.1 per cent. contr. and 5.3 per cent. ext., was 100 per cent crystalline; the lowest T. S., 40,693, with 3.9 contr. and 2.1 per cent. ext, was 75 per cent. crystalline. The all fibrous irons showed from 12.2 to 22.5 per cent. ext., 17.3 to 32.5 contr., and T. S. from 43 426 to 49,615 pounds per square inch. The fibrous irons are therefore of medium tensile strength and high ductility. The crystalline irons are of variable T. S., highest to lowest, and low ductility.

Lowmoor Iron Bars.—Three rolled bars 2½ inches diameter; tensile tests: elastic, 23,200 to 24,200; ultimate, 50,875 to 51,905; contraction, 44.4 to 42.5; extension, 29.2 to 24.3. Three hammered bars, 4½ inches diameter, elastic, 25,100 to 24,200; ultimate, 46,810 to 49,223; contraction, 20.7 to 46.5; extension, 10.8 to 31.6. Fractures of all 100 per cent. fibrous. In the hammered bars the lowest T. S. was accompanied by lowest ductility.

Iron Bars, Various.—Of a lot of 80 bars of various sizes, some rolled and some hammered (the above Lowmoor bars included) the lowest T. S. (except one) 40,808 pounds per square inch, was shown by the Swedish "hoop L" bar 3¼ inches diameter, rolled. Its elastic limit was 19,150 pounds; contraction 68.7 per cent., and extension 37.7 per cent. in 10 inches. It was also the most ductile of all the bars tested, and was 100 per cent. fibrous. The highest T. S., 60,780 pounds, with elastic limit, 29,400; contr., 36.6; and ext., 24.3 per cent., was shown by a "Farnley" 2 inch bar, rolled. It was also 100 per cent. fibrous. The lowest ductility 2.6 per cent. contr., and 4.1 per cent. ext. was shown by a 3¾ inch hammered bar, without brand. It also had the lowest T. S. 40,278 pounds, but rather high elastic limit, 25,700 pounds. Its fracture was 95 per cent. crystalline. It thus appears that of the two bars showing the lowest T. S., one was the most ductile and the other the least ductile in the whole series of 80 bars.

Generally, high ductility is accompanied by low tensile strength, as in the Swedish bars, but the Farnley bars showed a combination of high ductility and high tensile strength.

Locomotive Forgings, Iron.—17 tests, average, E. L., 30,420; T. S., 50,521; contr., 36.5; ext. in 10 inches, 23.8.

Broken Anchor Forgings, Iron.—4 tests, average, E. L., 23,825; T. S., 40,083; contr., 3.0; ext. in 10 inches, 3.8.

Kirkaldy places these two irons in contrast to show the difference between good and bad work. The broken anchor material, he says, is of a most treacherous character, and a disgrace to any manufacturer.

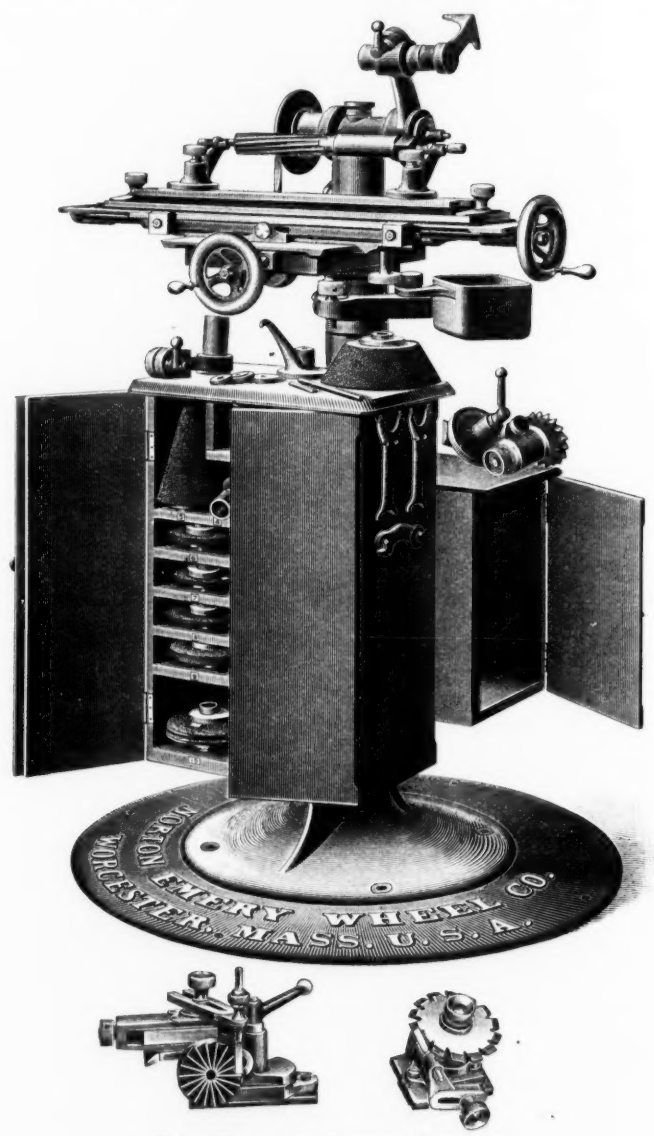
Iron Plate Girder.—Tensile tests of pieces cut from a riveted iron girder after twenty years' service in a railway bridge. Top plate, average of 3 tests, E. L., 26,600; T. S., 40,806; contr., 16.1; ext. in 10 inches, 7.8. Bottom plate, average of 3 tests, E. L., 31,200; T. S., 44,288; contr., 13.3; ext. in 10 inches, 6.3. Web plate, average of 3 tests, E. L., 28,000; T. S., 45,902; contr., 15.9; ext. in 10 inches, 8.9. Fractures all fibrous. The results of 30 tests from different parts of the girder prove that the iron has undergone no change during twenty years of use.

Steel Plates.—Six plates 100 inches long, 2 inches wide, thickness various .36 to .97 inch. T. S., 55 485 to 60,805; E. L., 29,600 to 33,200; contr., 59.5 to 56.2; ext., 17.99 to 18.12.

Steel Bridge Links.—40 links from Hammersmith Bridge, 1886.

	Elastic Stress. Pounds.	Ultimate Stress. Pounds.	Deflection at 50,000 Pounds.	Ultimate Deflection.
Hardest .	34,300	60,960	3.24 ins.	8
Softest...	32,000	56,740	3.76 "	8
Mean.....	32,763	59,209	3.53 "	8

All uncracked at 8 inches deflection.



New Tool and Cutter Grinder.

	T. S.	E. L.	Contr.	Ext. in 100 Ins.	Fracture. Silky.	Fracture. Granular.
Average of all.	67,294	38,294	34 5	14 11⅛		
Lowest T. S..	60,753	36,030	30.1	15.51	30%	70%
Highest T. S. and E. L ..	75 936	44,166	31.2	12 42	15	85
Lowest E. L...	64,044	32,441	34.7	13.43	30	70
Greatest Contraction.....	63,745	38,118	52.8	15.46	100	0
Greatest Extension	65,980	36,792	40.8	17.78	35	65
Least Contr. and Ext....	64,980	39,017	6 0	6 62	0	100

The ratio of elastic to ultimate strength ranged from 50.6 to 65.2 per cent., average, 56 9 per cent.

Extension in lengths of 100 inches. At 10,000 pounds per square inch, .018 to .024; mean, .020 inch; at 20,000 pounds per square inch, .049 to .063; mean, .055 inch; at 30,000 pounds per square inch, .083 to .100; mean, 090; set at 30,000 pounds per square inch, 0 to .002; mean, 0.

The mean extension from 10,000 to 30,000 pounds per square inch increased regularly at the rate of .007 inch for each 2,000 pounds per square inch increment of strain. At this rate, if the rate of extension had been the same from 0 to 10,000 pounds the extension at 10,000 pounds would have been .035 inch, instead of .020 inch. The increments below 10,000 pounds are not given by Kirkaldy. The difference between .020 inch and .035 inch indicates a probable error in the initial measurements of extension. An increase of elongation of .007 inch for increments of 2,000 pounds strain corresponds to a modulus of elasticity of 28,571,429. The least increase of extension for an increase of load of 20,000 pounds per square inch, .065 inch, corresponds to a modulus of elasticity of 30,769,231, and the greatest, .076 inch, to a modulus of 26,315,789.

Steel Rails.—Bending tests, 5 feet between supports, 11 tests of flange rails 72 pounds per yard, 4.63 inches high.

Pulling tests of pieces cut from same rails. Mean results 11 rails.

	Elastic Stress. per Sq. Inch.	Ultimate. Pounds per Sq. inch.	Extension in 10 Ins.	Contraction of area at fracture
Top of rails.....	44,200	83,110	13.5%	19.9%
Bottom of rails..	40,900	77,820	22.8%	30.9%

Thrusting tests of short pieces cut from same rails. Top of rail, elastic stress per square inch, 43,000 pounds. Depression set in one inch at 100,000 pounds per square inch 8.3 per cent., at 150,000 pounds per square inch 23.7 per cent.

Steel Tires.—Tensile tests of specimens cut from steel tires.

Krupp Steel.—262 Tests.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	69,250	119,079	31.9	18.1
Mean.....	52,869	104,112	29.5	19 7
Lowest...	41,700	90.523	45.5	23.7

Vickers, Sons & Co.—70 Tests.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	58,600	120 729	11.8	8.4
Mean. ...	51 066	101,264	17.6	12 4
Lowest...	43,700	87,697	24.7	16.0

Patent Shaft and Axle Tree Co.—182 Tests.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	54,600	91 588	26 9	17.8
Mean.....	43,628	73,782	40.8	21 7
Lowest...	37,750	53,737	5 7	6.0

Note the correspondence between Krupp's and Vickers' steels as to tensile strength and elastic limit, and their great difference in contraction and elongation. Notice the much lower T. S. and E. L. of the third group, the great difference between highest and lowest, and the low ductility of the steel of lowest tensile strength. This last must have been a bad sample. Its fracture was 100 per cent. granular. The fractures of the Krupp steel averaged 22 per cent. silky, 78 per cent. granular; of the Vicker steel, 7 per cent. silky, 93 per cent. granular; and of the Patent Shaft and Axle Tree Co. steel, 64 per cent. silky, 35 per cent. granular. Kirkaldy's report does not show which steel proved the best in actual service.

Steel Axles.—Tensile tests of specimens cut from steel axles.

Patent Shaft and Axle Tree Co.—157 Tests.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	49,800	99,009	21.1	16.0
Mean ..	36,267	72,099	33.0	23 6
Lowest..	31,800	61,382	34.8	25 3

Vickers, Sons & Co.—125 Tests.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	42,600	83,701	18.9	13 2
Mean ...	37,618	70,572	41 6	27 5
Lowest..	30,250	56,388	49.0	37 2

The average fracture of Patent Shaft and Axle Tree Co. steel was 23 per cent. silky, 67 per cent. granular.

The average fracture of Vickers' steel was 88 per cent. silky, 12 per cent. granular.

Tensile tests of specimens cut from locomotive crank axles.

Vickers'.—82 Tests, 1879.

	E. L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	26,700	68,057	28.3	18.4
Mean ..	24,146	57,922	32.9	24.0
Lowest..	21,700	50,195	52.7	36.2

Vickers'.—78 Tests, 1884.

	E. L.	T. S	Contr.	Ext. in 5 Inches.
Highest .	27,600	64,873	27.0	20.8
Mean . ..	23,573	56,207	32.7	25 9
Lowest...	17,600	47,695	35 0	27.2

Fried. Krupp.—43 Tests, 1889.

	E L.	T. S.	Contr.	Ext. in 5 Inches.
Highest..	31,650	66.868	48.6	35.6
Mean.....	29,491	61,774	47.7	32.3
Lowest..	21,950	55,172	55.3	35.6

Note the difference in Vickers' steel between 1879 and 1884. The average fracture in both lots was 77 per cent. silky, 23 per cent. granular. The average fracture in Krupp's steel was 95 silky, 5 granular. Note the combination of high T. S. and high ductility in Krupp's steel.

Steel Propeller Shafts.—Tensile tests of pieces cut from two shafts, mean of four tests each. Hollow shaft, Whitworth, T. S., 61,290; E. L., 30,575; contr., 52.8; ext. in 10 inches, 28.6. Solid shaft, Vickers', T. S., 46,870; E. L. 20,425; contr., 44.4; ext. in 10 inches, 30.7.

Thrusting tests, Whitworth, ultimate, 56,201; elastic, 29,300; set at 30,000 pounds, 0.18 per cent.; set at 40,000 pounds, 2 04 per cent.; set at 50,000 pounds, 3.82 per cent.

Thrusting tests, Vickers', ultimate, 44,602; elastic, 22,250; set at 30,000 pounds, 2.29 per cent.; set at 40,000 pounds, 4.69 per cent.

Shearing strength of the Whitworth shaft, mean of four tests, was 40,654 pounds per square inch, or 66.3 per cent. of the pulling stress. Specific gravity of the Whitworth steel, 7.867; of the Vickers', 7.856.

A New Tool and Cutter Grinder.

The illustration given herewith shows the No. 4 Walker cutter and tool grinder, manufactured by the Norton Emery Wheel Co., Worcester, Mass. It is designed to cover the field for sharpening all ordinary milling cutters and straight, spiral or taper fluted reamers, rose reamers, etc.

The engraving shows the machine as arranged for grinding a spiral toothed reamer or any similar work held upon centers.

The sliding carriage has a transverse movement by means of a screw and hand-wheel, or it may be quickly adjusted by a separate slide and clamp. It is also adjustable in all directions, and swings completely around the column, clamping in any position.

At the foot of the machine two attachments are shown. One of these is for grinding gear cutters, and is arranged for indexing the teeth and grinding the faces truly radial as they should be.

The other attachment is for grinding face mills on the ends of shank cutters. This attachment is provided with a universal holder

for either straight or taper shanks up to 2" diameter, thus doing away with the necessity for collets, sleeves, etc. Using a face wheel, and being provided with means for adjusting to any desired angle in a vertical plane, the required clearance can be readily obtained, and it is a straight line instead of a concave clearance, which conduces much to durability of the cutting edges.

Some of the special features of this machine are: Eighteen selected emery wheels mounted on interchangeable iron centers or collets ready for instant use; a sliding carriage with hand or screw feed and automatically adjustable for wear; dust-proof boxes and taper spindle with extremely simple take-up, and a large oil chamber; every sliding and revolving surface thoroughly protected from grit; all waste oil from spindle boxes conveyed to drip pan in center of column; a cabinet for the emery wheels, and one for tools each attached to the column, making a very convenient arrangement.

Armstrong Tool Holder.

We present herewith an illustration of the Armstrong tool holder in use in a planer or shaper. This holder consists of a steel stock, the top and bottom of which are planed square with the sides, and near the end is a hole which is drilled and squared from the solid metal and put through at such an angle as to give the proper top rake to the cutting tool, which is inserted in this hole and held in place by the set-screw shown, the axis of this set-screw being at right angles to the tool, so that the screw comes down fairly upon it. The holder is case-hardened, and the screw, which is of steel, has a hardened point. The tools are usually made of self-hardening steel and ground to shape, the comparatively light weight of each of them enabling the best steel to be used. It is made in five sizes, varying from $\frac{3}{8}$"x$\frac{3}{4}$" to 1"x1$\frac{1}{8}$", and using cutters from $\frac{3}{16}$" to $\frac{1}{2}$" square, by the Armstrong Bros. Tool Co., 78 Edgewood avenue, Chicago, Ill.

Molding by Machinery, Foundry Appliances, Etc.—II.

By S. Bolland.

LOAM MILL.

Another of the evidences of a growth in the desire for best methods is the adoption of the mill for grinding loam where such a commodity is in constant demand. Old as this contrivance is, it is nevertheless a fact that in many foundries they are still pounding away on the chopping bench, apparently ignorant of the existence of such a machine; others claim that hand made loam is the best, but this cannot be any other than a wild statement, having no ground in fact. With such a mill as is shown at Fig. 7, loam may be ground to any consistency desired, according to the amount of clay and manure and the nature of the sand used.

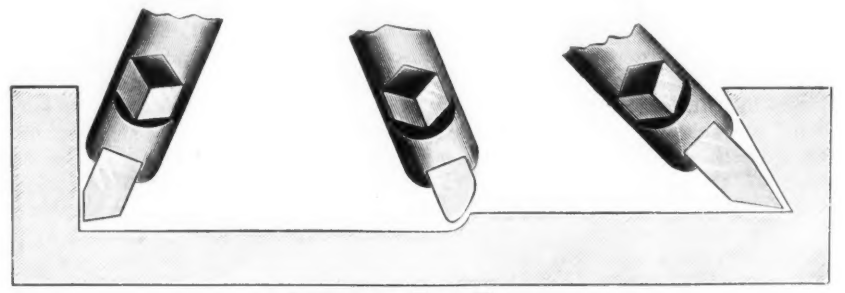
The machines that are sometimes erected for this purpose are not suitable, being simply a copy of those used in cement and other factories; one chief objection to most of them is the outrigging required for carrying the gearing, which is usually on the top. The one shown at Fig. 7 is the best mill for the foundry, being provided with a shute through which the loam or claywash may escape when it has been sufficiently ground, and its usefulness may be still further enhanced by a system of hoppers overhead for the introduction of the sand, clay, etc.

MOLDERS' CLAMPS.

Even the ordinary light-work molders' clamp receives some attention during this age of improvement; amongst many other excellent contrivances may be classed the ones seen at Figs. 8 and 9; the latter, although ingenious and sure, might be objected to on account of the protruding handle, but its other acceptable features will, in many instances, compensate for that. The dilapidated condition of the top edges of wooden flasks caused by that outlandish mode of pinching now so prevalent, as well as the many failures from jarring of iron copes whilst driving wedges, ought to impel every founder to invent something more elegant and satisfactory than are the crude devices invariably practiced. In nothing does the spirit of improvement seem so backward as is the case in this particular, almost everywhere.

GEARED LADLES.

There is every evidence of shiftlessness and culpable neglect when, as is sometimes the case, we see a dozen men struggling to pour a casting from a six ton ladle provided with no other means for such an operation than the old crutch bars at each end. When Naysmith, the great English mechanic, added to the pivot of a crane ladle a tangent screw and worm-wheel by which it might be gradually tilted by one man standing conveniently near by, he made every molder in the universe his debtor, and no founder should hesitate, on the ground of expense or for any other reason, in providing such safe means as this valuable invention secures. The difference between the two devices is a striking one, and compensates, in a large measure, for the very meager conveniences supplied by our too-easy ancestors. What the writer believes to be the chief characteristics of a good geared ladle will be found in an article on that subject in the American Machinist, August 4th, 1892.



Armstrong Tool Holder.

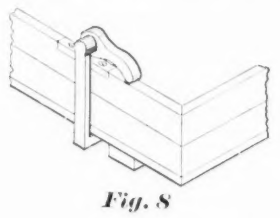


Fig. 8

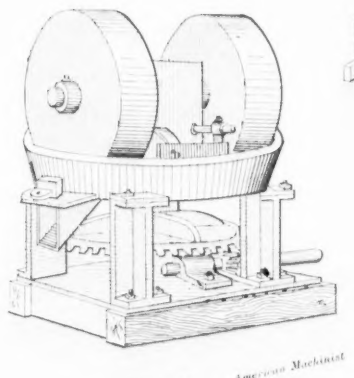


Fig. 7

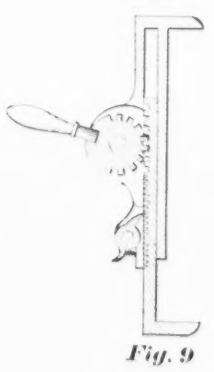


Fig. 9

HAY AND STRAW ROPES.

We noticed how anxious were the founders of almost every country to possess one of the hay-twisters shown at Fig. 10 when they were first placed on the market, but this may not have been occasioned by a desire to be abreast of the times so much as that their superiority over the old patriarchal ways, from a monetary point of view, was so manifest as to check all opposition to their general adoption wherever large quantities of hay or straw ropes were used. However, we are willing to class this with the other evidences of a general desire for a more practical and rational adoption of any mechanical contrivance which will not only save labor, but also add dignity to a much-abused trade.

As seen, this machine makes the hay or straw rope, and winds it up into a coil for transportation. Rollers draw the hay from the trough, and the twisting is effected by a planetary action of the rollers longitudinally; it is then coiled on the reel.

Since the introduction of the above-described machine there have appeared others of more or less merit, but with many it remains a matter for conjecture whether there has been any substantial improvement made.

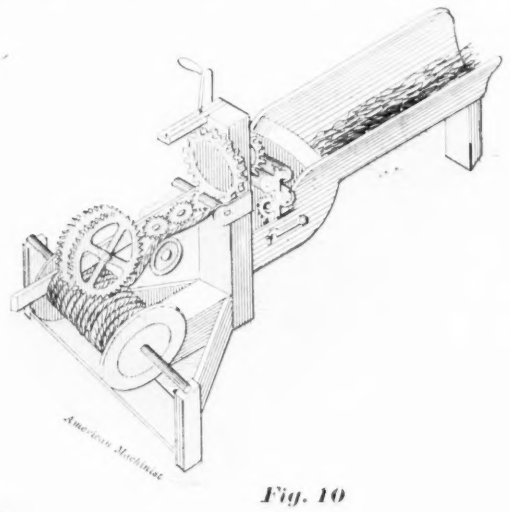


Fig. 10

GEAR MOLDING BY MACHINERY.

Owing to the various difficulties caused by irregular ramming, unequal expansion of patterns arising from the different degrees of dampness in the sand, as well as the almost certain destruction of some parts of the mold during the withdrawal of the pattern, and which could at best be but approximately repaired, it is safe to say that very few gear wheels of magnitude were ever made before Jackson, of Manchester, England, invented his machine for forming part of the mold, and spacing the teeth with mechanical accuracy in the sand, one tooth only being used for producing the whole number contained in the wheel, this one tooth being alternately raised and lowered by suitable machinery, which not only draws the pattern with absolute precision, but travels to the next tooth as precisely as could happen in the best gear cutting machine.

Everything points to the fact that the principle of Jackson's machine was first suggested to him by the method of molding gear wheels which was then finding favor at most of the large millwright shops in his immediate neighborhood, and which will be found fully explained in *The Iron Founder*. The scheme therein described for forming the cope and bottom bed, as well as the arms, being substantially the same as adopted by him; in fact, if the reader will carefully examine the whole subject he will see clearly that the wheel molding machine is simply the application of a method for spacing the teeth, and insuring a better draw of the same.

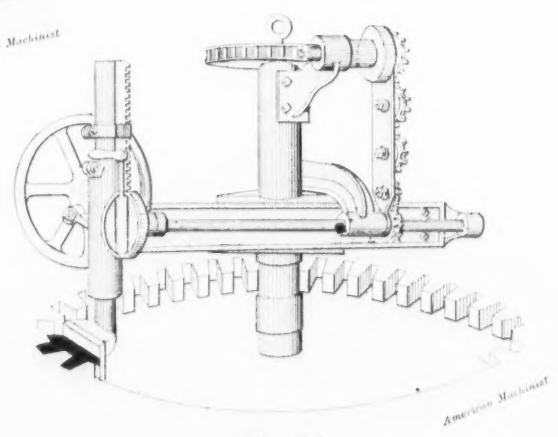


Fig. 11

Since the introduction of the above machine many others have sprung into existence, notably the Scott, Bellington and Darbyshire, Whittaker's, Buckley and Taylor's, and Simpson's. With the exception of the latter, all these machines are actuated by change wheels for effecting the regular movement of the same, but the Simpson machine is worked independent of such means, thus obviating any inaccuracy consequent on the wear and tear of the several wheels employed. The pitching of the teeth is somewhat after the manner of the division plate and index pin of a geometric lathe, and on these machines a sheet-iron drum is secured to the top of the central column of the machine, and perforated with a series of circles of holes, giving a large range of numbers suitable for different numbers of teeth. A peg is made to fit into these holes, passing through a hole in the vertical arm attached to the horizontal arm which carries the tooth-block, and so locks the machine accurately during the ramming of each separate tooth. The horizontal or carrier arm slides vertically on the central pillar, and when adjusted for height is kept in position by means of a collar upon which it rests. A slot in the arm permits of a movement upon the horizontal slide operated radially by a screw and hand-wheel; through this slide passes a screw and a guide rod for imparting a vertical movement to the tooth-block. The tooth-block is elevated by a hand-wheel and miter-wheel; provision is made by a hand-wheel and slot for setting the blocks of bevel wheels at any required degree of angle.

Fig. 11 is a rough sketch of a molding machine for wheels when the spacing is actuated by change wheels. It is seen at *A* that a pattern is used corresponding to a small portion of the gear to be molded; this pattern includes two teeth and the interdental space, when spur gears are to be molded, and is attached to the lower end of the vertical guide bar, which slides in ways formed at the end of a horizontal support, which has a radial position relatively to a central spindle or arbor. By this means the pattern is carried around, and, being made to descend upon the bed previously formed, gives, after ramming, the proper impression for that portion of the gear wheel which corresponds to it. It is used to mold gears from nine inches up to six feet in diameter, either spur, bevel, miter, mortise, or worm-wheels, plain or shrouded; and it is also equally applicable to molding fly-wheels or pulleys, either plain or shrouded.

OTHER LABOR SAVING DEVICES—CASINGS.

Casings in which to form the outer, and, in some instances, both outer and inner parts of crystallizing cones for chemical works, as well as sugar pans and numbers of kettles, etc., were a natural outcome of the ever-increasing demand for such articles, and which could not have been met by the usual practice of molding in bricks and loam. The same may be said with regard to the rapid growth of the pipe trade consequent on the general outcry for a pure and plentiful water supply; the creeping methods of molding on the flat in green sand had to be abolished ultimately in favor of vertical molding in iron casings, which latter suggested the application of said methods to hydraulic rams, and all castings that could by this means be made without external ramming in the pits, vide *The Iron Founder*, page 186.

PIT RAMMING.

When the loam molder in ramming up large bodies of sand in pits sought out

weights and big logs to occupy spaces of more than ordinary dimensions, thus reducing the time consumed in ramming as well as making a harder body for the mold to press against, he was sowing the seeds which ultimately blossomed into the well-kept curbs which could be fastened together at any convenient distance from the mold, making the containing of the latter independent of whatever space might be outside. The climax was reached when he confined all of his mold in suitably contrived casings, in which the mold was prepared from the outset.

WORM PINIONS, ON END.

We can well remember when it was first suggested to mold a worm pinion by drawing it out of the sand endwise, and, by that means, save the unsightly joint. "Pooh! pooh!" exclaimed the conservative molders around, but just as soon as a suitable pattern—with the necessary appendages for supporting and guiding the same—was furnished, the feat was accomplished without trouble, to the very evident dissatisfaction of the doubters. Now we have some pretty long pieces of conveyer screw formed in the sand by first forming a plain cylindrical mold, and afterwards forming the thread by screwing a short section of pattern through the mold.

SCREW PROPELLERS.

It is very evident that there has been a steady improvement in the ways of molding screw propellers from the first; the writer remembers some very roundabout methods which at that time were considered perfection; since then, however, large numbers of patents have been granted for improved methods of sweeping, flask forming, and ramming, all evincing that there was a keen competitive spirit abroad. Following close on the heels of some late improvements by molding in fixed flasks from one blade pattern only, comes still another patent for forming the blades separately by a sweep and an adjustable knife, which forms the blade independent of a pattern altogether.

It is very encouraging to notice that most of these late inventions for propeller-making devices belong to practical molders, some of whom are now working at the trade, clearly showing that we, as a class, are in the race for a legitimate share of the thinking.

BLOCK AND PLATE MOLDING.

A short review of the two methods—block and plate molding—will serve to show that the spirit of invention was abroad in the foundries when some of the oldest of us were boys; how much these early attempts have helped in bringing about the present elaborate systems will be apparent when a full knowledge of the modes then employed is obtained. Plaster blocks were invented to make the molding of thin delicate register work, as well as other long thin castings having more or less elegance of design, a more easy and safe operation, and consisted of taking plaster casts of each side of the pattern, then from both these impressions other plaster casts were taken in top and bottom match flasks, the latter then serving to ram thereon cope and nowel respectively, exclusive of the original pattern. Such molds are, in all cases, an exact duplicate of the pattern, free from all the imperfections usually attending the molding of very light work by the common practice.

The necessity for producing small work of all descriptions at a more rapid rate, and with greater accuracy, suggested the principle of what is called plate molding, which consists of flasks well fitted, and with planed edges to receive a plate betwixt, upon either side of which are the respective halves of the several castings, connected by the running gates. The pinning of these flasks is so arranged that the cope may be set down face up, upon which the plate is then pinned, to be followed by the nowel, which is at once rammed. After turning all three over, the gate pin is set into a socket over the main runner, the cope rammed and separated, when, after a slight jarring, the plate is lifted off, exposing all the molds with gates ready cut, leaving nothing to be done except to set in whatever cores are needed and close the mold. Should the cope side of the plate offer any difficulty in effecting a clean lift, the nowels and copes can be rammed alternately; by this means the plate is lifted away from the mold in both cases, thus insuring a clean separation. The very excellent idea of fitting flasks interchangeably originated with these two methods.

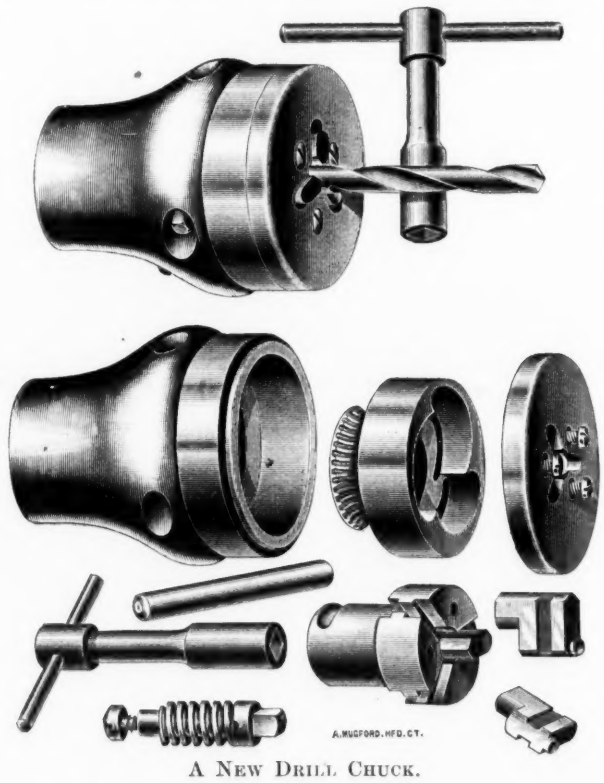
MOLDING MACHINES.

The stripping plate, which constitutes one of the chief elements of the modern molding machine, is not by any means a new invention; some of the first were made over thirty years ago by a large manufacturer of cotton machinery in Oldham, England, for the production, at a cheaper rate, of pulleys, wheels, and other small work too numerous to mention. Compared with some of the elaborate systems of stool plates, etc., on some of the present machines, these early efforts were no doubt somewhat rude; still, it is evident that the principles upon which the present methods are based are one and the same with the past—the patterns projected through the plate and were withdrawn underneath by means of levers before the rammed flask was lifted off. Some were rolled over with the flask, and the pattern pulled through.

The question is sometimes asked by parties opposed to machine molding, "Is the investment in machines and other appliances for a foundry justifiable?" And the reply readily comes that "you are justified in putting a plant into a foundry, and that every part of it should be as good as it can be made." They claim, and not without reason, that, with the exception of some minor devices, the foundry employs the old podauger methods, and, further, that inasmuch as no man would hesitate to put new tools into his machine shop that would save fifty per cent. of what the labor costs ought to hesitate when a similar inducement is offered in the foundry. They furthermore assert that, owing to the superintendent being invariably a machinist and not a molder, and while he is conscious that present methods are neither economical or progressive—being unacquainted with the work—he defers to his foundryman, who wants his foundry improved but considers molding an art and not a trade for which machines can do the thinking. The latter assertion may be correct in some instances, but we know of places where the exact reverse is the case; and even now there are many firms where machines are in active operation under the immediate supervision of superintendents who are not molders, and where the foreman molder devotes his whole energy to make the machines a success, and this with astonishingly successful results.

Another authority upon this subject says, "The all absorbing question: 'What is the economy in machine molding?' is very difficult to answer. The product of machines will vary in different foundries as much as the product of the molder. What may be called a fair day's work is an unsettled question. A machine that will mold 175 flasks, 16x16x10 inches deep, with two men to operate it in one foundry, would, under precisely the same conditions, mold 250 in another. One manager may surround his machine with conveniences for handling the work and thus increase his product, while another would compel his machine men to work under disadvantages. The treasurer and practical shopman of a foundry were observing the operations of an automatic machine, with watch in hand. A complete half mold in 16-inch nowel, 5 inches deep, had just been made and turned on the floor for inspection in ten seconds after the sand was put into the flask, when the treasurer asked the question, 'How many molds can be made in a day?' Before any reply could be given the shopman said, 'That's not the question; the question is, How many molds can we take care of?' A better answer could not have been given."

The conditions are not at all favorable when all the sand is handled by shovels, and the molds carried to and fro by hand. The authority above quoted, in speaking of this, says: "Two men on this machine make 200 molds per day, and average during the working hours from twenty-seven to thirty-four molds per hour. These men have made and carried away 158 nowels in one hour and thirty-five minutes, and have made 200 complete molds ready for clamping in less than five hours. The flasks used in this case were 14x17x10 inches deep, and weigh seventy pounds; the sand in the flask when rammed weighs 156 pounds. We must keep in mind that these two men must shovel into flasks over 31,000 pounds of sand, and carry off the same amount in making 200 molds; they must also handle twice 14,000 pounds of iron in flasks. 200 molds under these conditions is too much for five hours' work, but this number is not too much for a day's work for two men. A greater product might be obtained from an additional man, or a conveyer for elevating sand to a hopper over the machine. A system of handling the molds after they are made would also add to the machine's capacity."



A New Drill Chuck.

A New Drill Chuck.

We give with this, engravings showing the general appearance and construction of a new drill chuck which has been brought out by the E. Horton & Son Co., Windsor Locks, Conn. By reference to the engravings it will be seen that the chuck has three jaws which are moved radially in and out by means of a cam ring that is turned by a worm; which gives a very powerful grip and good wearing qualities. All parts of the chuck, except the outer case or body, are made of steel, the jaws being of tool steel hardened and tempered. The cap which goes over the front of the chuck after the jaws are in place is so arranged as to add to the strength of the chuck, while it effectually excludes dirt and chips from the working parts. The gripping surfaces of the jaws are ground to insure accuracy, and their bearing upon the cam surfaces is $\frac{9}{16}$ inch long and $\frac{5}{16}$ inch wide—sufficient to wear well and keep the jaws accurately in place with their faces parallel. The jaws cannot be run out of the body of the chuck when in use, and there are no projections of any kind beyond the body. The chuck is at present made in only one size, for holding drills from the smallest to $\frac{1}{2}$ inch diameter.

LETTERS FROM PRACTICAL MEN.

Standard Catalogues and Business Cards.

Editor American Machinist:

Your advocacy of a 6x9 standard size for catalogues seems to me to be a step in the right direction, and I think that a further step might be taken with advantage toward a standard size for business cards. Probably no better size could be agreed upon than the standard card now used by libraries in cataloguing books. These cards are made to fit in drawers 5 inches wide, and are made about one-sixteenth smaller than 5x3 inches each way, in order to clear.

As soon as the cards accumulate to any extent many fixtures will be useful in order to handle them conveniently. These are in the market for this standard size.

For the purpose of sorting, an additional feature of value would be a standard form of heading for the cards in which the surname is printed first, as in the directory lists.

Such cards could be preserved and placed where they can be referred to readily for any of the varied information placed upon them. The present miscellaneous sizes of cards are rarely kept, but merely used for the purpose of copying the address on them into address books, and then thrown away, so that whatever additional information they may contain is lost.

I inclose a standard library card marked with the exact dimensions and indorsed as above suggested*.

A similar indorsement of the name at the top of the cover on the standard catalogues would also be a great convenience in looking over files. S. W. Balch.

Yonkers, N. Y.

Cam Rolls Again.

Editor American Machinist:

I wish to express my thanks to a writer signing himself "Easy Way" in your issue of March 30, page 5, for his complimentary remarks regarding one of my cam-driven machines. I am surprised, however, that he is surprised at an imaginary error which he thinks I have fallen into, and this writer seems to be so mixed up in his attempted understanding of my remarks that it is certainly an "easy way" to avoid the responsibility of such "mixed-up-ed-ness" to write under a *nom de plume*, rather than to sign his name.

I did say, and I meant it, that a conical roll would not only fill a groove in a "side cam," but would follow the side of such a groove with a true rolling motion, providing the cam gave an infinitely small amplitude of motion to its follower, in which case it would, of course, be practically no cam at all. Such a groove would obviously lie in a normal plane with the axis of the cam shaft. I did further say that it would not roll correctly when the cam groove departed from this normal plane. It could, however, be made to fill the groove at all points, at any rate upon a cam of comparatively large diameter, as the groove could be cut at each point of its length to fit the roller, exactly as if it was milled out by a conical cutter of the same shape and size.

Furthermore, I did not express any inability to fix an angle for the cone. I merely suggested that the best practical way to make it was at some intermediate point between a cylindrical form and a cone whose apex was at the axis of the cam shaft. This was not to attain any theoretically perfect shape, but simply to get a practical compromise between two incorrect shapes.

As a matter of fact, I have used both cylindrical rolls and conical ones, the latter with various degrees of taper between the "bevel gear" style referred to and a style with no taper at all.

*[Card is 4⅛x2⅛ inches. The bottom line of heading or indorsement is $\frac{1}{16}$ inch from the top and the first letter commences $1\frac{3}{16}$ inch from the left-hand edge.—Ed.]

The other "odd thing" that your correspondent (near the end of his sixth paragraph) accuses me of pointing out, is not odd at all—as I don't point out any such thing, but say exactly the opposite, and agree perfectly with what he says in the last three lines of said sixth paragraph.

Your correspondent's method of making a barrel-shaped roll may be a good one where the cam groove is very roughly cut and the roll mounted out of line upon a "springy" follower with everything generally tipsy. It is obviously, however, a very poor way of fitting up good machinery, as such a spherically surfaced roll would touch at but one point of contact, and this would tend to crush the metal of both roll and cam—on account of these compressive members having insufficient section.

OBERLIN SMITH.

Patents and Patent Laws.

Editor American Machinist:

Mr. Redfield's letter in your issue of March 16, which, for some reason, did not catch my eye until now, I am very glad to see, notwithstanding I do not agree with him. There is an old fable concerning a fowl which laid golden eggs, excellently applicable to this patent business. The wise and unique patent law of the United States is the fowl, and the golden eggs are the inventions, which would never have been brought forth except for that law. These golden eggs are the foundation of our riches and prosperity, yet there are people who are willing to starve, if not to strangle this noble bird.

I think Mr. Redfield partakes of a prevalent and popular error. I think he believes that somehow the public have a claim upon an invention, and that fraud is committed if the inventor does not forthwith surrender it at the lowest price. This is a great mistake. The public has no claim whatever, either in law or ethics. The inventor possesses his invention not by grace or by statute, but by right of creation. He may do with it as he pleases. He may disclose and give it to the public or to an individual, or he may lock it in his own breast, and let it die with him. No one has either right or power to direct him, or right to complain of the course which he elects.

Now with reference to this possession, the people propose a bargain, to wit: in consideration of a disclosure, we agree to let your use of it be exclusive for 17 years. There is no compulsion, and the inventor may accept or reject this proposition as he sees fit. Many do reject it, preferring to keep their inventions secret for all time or so long as they can. I am informed that Mr. Edison has done so in the matter of the phonograph wax cylinders.

Everybody knows that after the patent is granted the real battle begins. In the first place the thing has to be "styled" and made, then the public has got to be *convinced* that money can be saved by using it. This usually takes a respectable part of the life of the patent. Then just so soon as a public demand has been *created* by the efforts of the inventor or his representatives, infringers begin to drop in to share the profit. By the time these have been fought off the patent will be well on toward its death. This is a frequent history and is familiar to many inventors. If it is true that but few patents profit their inventors, the cause is largely in the pirates who are ever willing to steal the brains and profits which belong to another.

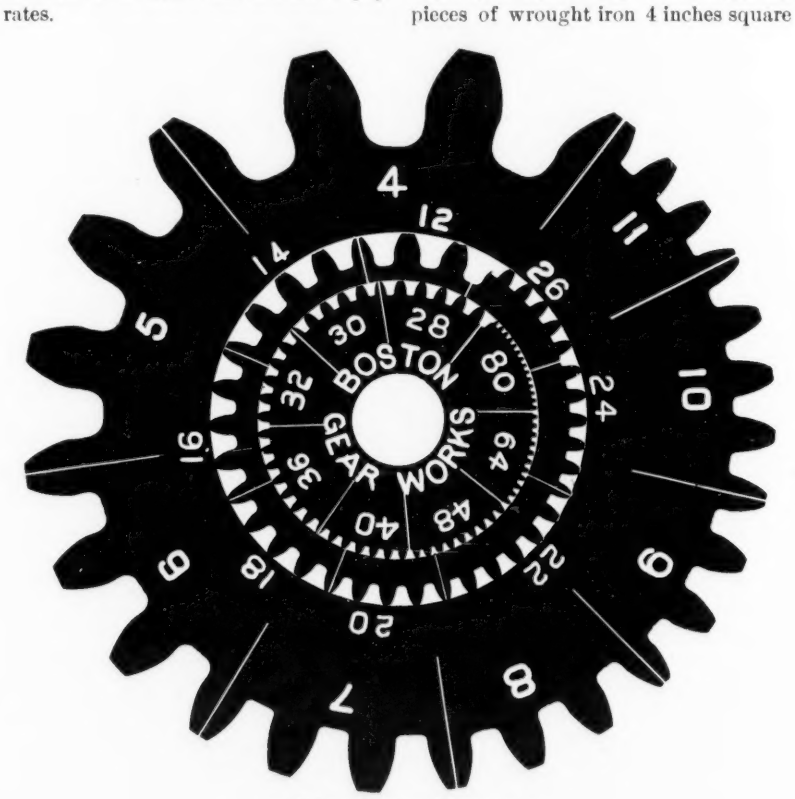
It cannot be doubted that anything tending to still further limitation of an inventor's chances to make something out of the invention will tend to discourage inventors, and cause more of them to take chances in secrecy.

It would be good policy to lengthen the term rather than shorten it, and to remove the power of United States courts to review the action of the commissioner in granting the patent. The major part of the time and expense in patent litigation is consumed in efforts to convince the court that the commissioner violated his duty in granting the patent. That is all wrong. The act of the commissioner ought to be res judicata, so far as the patent office records are concerned, and wealth would then be shorn of most of its power of oppression.

The instances where delay works any harm to the people could be counted on the fingers of one hand, although those given to moralizing for other people can easily figure out hardships founded upon "if."

Before I can possibly suffer for the possession of something, I must not only be aware of its existence, but must be acquainted with the use of it. No one can suffer because of nonpossession of an invention of which he is in ignorance. Before 1876 no one experienced any suffering for lack of telephones. In fact, the telephone had been in existence for a number of years, and was known to many, yet it waited for Mr. Hubbard and his associates to convince the people that it could be made useful and profitable to them. Supposing that event had been delayed, wouldn't we have gone on just as happily as before?

No persons have been more thoroughly abused than the Bell Company, yet the reason in it is not very apparent, when it is considered that no one uses a telephone except upon the basis of remaining profit after the rates are paid. There is no compulsion, and millions of us don't use, and don't pay any rates.



GEAR TOOTH GAUGES.

So it all comes down to a nut shell. The invention belongs to the inventor. He may accept the people's offer, and part with it, or he may keep it himself. In either event his rights are *exclusive* as provided under the constitution. We may trust human nature and self-interest to cause him to make it accessible to such of the public who can make it profitable to themselves under the terms prescribed by the inventor. At the expiration of the patent we can make it ourselves if we want to. In the mean time no question of justice enters in, because the rights of the inventor are exclusive—and the public never gain even quasi rights by stretching out a helping hand. The inventor always has to pay for any assistance he may get.

Mr. Redfield apparently forgets that the inventor has no protection during the period his application is pending, and therefore his monopoly cannot be extended by such delay.

R. D. O. SMITH.

Tempering Small Pieces.

Editor American Machinist:

In the issue of the AMERICAN MACHINIST for March 9, Mr. H. Hardinge describes an excellent device for tempering small work. I presume that I am not the only machinist that does not have a supply of gas on tap, and as I have a good deal of small work to temper, some means more convenient than a forge fire had to be devised.

I have used for several months a kerosene oil burner made by the company to whom Mr. Hardinge refers, which, with the furnace that accompanies it, makes a satisfactory arrangement. It does not smoke the work, can be easily heated hot enough to melt cast-iron, and can be lighted almost as quickly as gas. It does require a connection with a chimney. For very small work—less than $\frac{3}{16}$ inch diameter and 1 inch long—I use alcohol, placing the piece to be heated on a piece of charcoal and using a mouth blowpipe with the hole in the tip as large as I can fill when blowing rather hard. As Mr. Hardinge says, there seems to be nothing superior to the alcohol for drawing the temper on small work, and he might also add, for tinning small pieces for "sweating" and light soldering. Small pieces can be tinned, placed together and heated until the solder melts, and the flame extinguished with a puff of the breath, and the pieces allowed to cool without moving the hand which holds the work.

I have tempered saws the way Mr. Hardinge suggests in the issue of April 13, but have found that if the saw was heated hot enough to get to the cold plate hot enough to harden, that it must be so hot at first as to injure the steel.

I heat them in a box made of two pieces of wrought iron 4 inches square and $\frac{1}{2}$ inch thick, placed about $\frac{3}{16}$ inch apart, and three sides closed by a band riveted on. Place the saw between the pieces through the open side, heat the whole to the required heat, transfer to the cold plate, and shake out the saw. I am most successful in getting even results if the plate is covered with as much lard oil as will stay on. The saw will cool at once but will be hot enough to straighten, if the plate to flatten it is pressed down at once. One person can handle this alone. C. E. QUIMBY.

Tilton, N. H.

Clearance in Cylinders.

Editor American Machinist:

In your issue of March 30th, R. B. Owens tells us how to ascertain how much clearance we have at each end of our steam engine cylinders, but there is at least one objection to his plan. Suppose that the follower bolt heads project beyond the surface of the follow plate, and the measurement is taken to the surface of this plate? In that case the actual distance between the piston and the cylinder head, when the engine is on the center, will be less than his measurement makes it, unless he measures directly to one of the follower bolt heads, and may lead to disaster.

In the issue of April 20th, Benjamin F. Hetherington suggests what he calls a much more simple way.

If he ever tries it with a Corliss or other type of engine in which the cylinder head on the crank end is not easily removed, it is quite possible that he may discover that it is not so simple as it appears.

Suppose that we have a piston with narrow packing rings running well over the counterbore, and a large clearance on the crank end. We disconnect the connecting rod from the crosshead, and pull it forward until the piston strikes the cylinder head. Our packing ring has now sprung out into the counterbore, and it is no simple matter to get it back again. In giving us this plan he omitted one important point, namely, that before trying it the packing rings should be removed. W. H. WAKEMAN.

New Haven, Conn.

Brown & Sharpe Manufacturing Company's New Building.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., have contracted with Norcross Brothers, of Worcester, Mass., for a four-story fire-proof brick building to be known as "No. 1 Building Extension of 1893," of which we are able to give some particulars:

It is to be 163 feet long, 51 feet wide, with two wings 57 and 84 feet. The walls are 20″ thick with a 28″x4″ pilaster every 8 feet, and in each of the pilasters are 2 flues for use in the heating and ventilating system. The floors and roof are made of steel beams and brick arches. The beams do not rest on the walls, but are supported by metal framing consisting of steel Z-bar columns on the centers of the pilasters, a 15″ 32 pound channel iron between these and the cast-iron columns and a 20″ 100 pound steel girder in the center of the building. The floor beams are 15″ 80 pounds, the figures being for the framing for the second floor, which will support a safe load of 400 pounds; the safe load for the upper floors is 250 pounds per square foot. The cast iron columns on the first floor are 16″ diameter, 2″ thick, 17 feet high under the beams, and 16 feet apart. Between the beams of the other floors the height is 13 feet 6″. The roof beams are inclined so that the water runs to the center and is taken through the cast-iron columns. The roof is made of hollow, porous, terra-cotta tiles cemented on top and finished with five-ply tar and gravel roofing.

The lower floor is underlaid with concrete and all the floors consist of a layer of 3″ spruce, a second of 1¼″ spruce laid diagonally with the first and a top layer of 1⅛″ hard pine laid parallel with the 3″ spruce. Five-eighths of the wall space is taken up with windows.

The first floor is nearly on a level with the ground and is connected with the first floor of the present No. 1 building through the westerly wing (at the east there is a drive way), and the second and third floors are on a level and connect, through the wings, with the floors in the present building. The stairways are iron and are inclosed on the outside of the building proper.

The boiler stack is 125 feet high, and the heating apparatus will be placed in the extension of the basement of the central wing of the present No. 1 building.

The building will be used for the manufacture of machine tools and the total floor space will be about 50,000 square feet.

Gear Tooth Gauges.

We present with this an engraving of a set of gear tooth gauges made by the Boston Gear Works, 31 Hartford street, Boston, Mass. The gauges are usually made of sheet brass, but may be made of steel to order. They are designed either for testing the depth of gear teeth being cut, for the convenience of the draftsman in drawing tooth outlines, or for the designer in selecting the proper pitch gear for any given purpose; this being usually more satisfactorily done where gear teeth of all the available pitches are at hand for inspection. The engraving shows three separate gauges; the smallest being for pitches from 80 to 28; the intermediate size for pitches from 26 to 12, and the larger size from 11 to 4, diametral. Rack gauges are also made of all ordinary diametral pitches.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY

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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, MAY 11, 1893.

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A Department of Mechanics.

Some time ago in discussing the friction that exists between the engineer and the line officers of the navy, we stated that we thought there were some points in favor of the establishment of a department of mechanics under the government, which department should have charge of all mechanical work for the government.

The more we consider this matter and the more we discuss it with others whose opinions may be supposed to be worthy of consideration, the more firmly we are convinced that such a department of the government would be very advantageous in many ways.

The time has now come when the manufacturing interests of this country are scarcely inferior in importance to any other, and we think that any one who will take the trouble to examine into the matter a little will find fully as many reasons for the existence of such a department as for the existence of such departments as that of the Interior, Agriculture, Post office or most of the others.

Within this department we think that all mechanical work of whatever kind done by the government should be executed, instead of having it, as at present, scattered around among the departments, each one making or contracting for what it needs, whether it be naval vessels, cannons, small arms, coast survey instruments, astronomical instruments, or mail bags. It would not follow from this that all these various kinds of work should be done in one establishment, nor that all of such work should be actually done by the government, but the mechanical department should have supervision over all of it, and this department should be in charge of a chief officer and assistants qualified by nature, training and experience for the work they have to do.

For instance, we believe that the legitimate and the only really proper function of the Navy Department is to navigate and fight naval vessels, and that the making and repairing of naval vessels and their armaments might better be left to mechanics and engineers. By the same token we think that the proper business of the army is to carry on campaigns and fight battles, and that the making of shoulder guns, swords and cannons should be left to those who can make an exclusive specialty of such arts as are concerned in their production.

We believe that the rank and title of Commodore for a mechanic and engineer is a meaningless anomaly, and the employment of an army Captain in making guns an absurdity. A man who attains distinction in mechanical science or engineering should have a title and honors which mean something within the field occupied by him, and which should not be complicated by the use of the same title for men occupying entirely different positions, involving duties as different as is night from day.

Not long since a Captain was appointed to a position, the duties of which are not, or at least should not be in the least military, but purely mechanical and executive. A published statement of his qualifications for the position was as follows:

He was 17 years old when he entered the Naval Academy at Annapolis, and was graduated at the head of his class at the outbreak of the Civil War, so that he had an opportunity to see real service from the beginning of his career. In 1862 he was promoted to be Second Lieutenant. He served during the war in the Potomac flotilla, in the Gulf squadron, and in the monitor fleet at Charleston, S. C. He was one of the survivors of the "Patapsco" when she was blown up by a Confederate torpedo and lost two-thirds of her men. His services since the war comprise duty in the European squadron twice and some years in American waters, including a voyage on the "Congress" to carry relief stores to the explorer, Hall, and the command of the "San Francisco." He has also been in charge of the torpedo station at Newport, of the Annapolis Academy, and of the Washington Navy yard. He is said to be a strict disciplinarian.

Now we should say that this record is highly creditable to the gentleman referred to. But is it not self-evident that a man having such a record should remain during the active years of his life in a service where this record would be of some use to him, and where it would be proof of fitness for the position occupied? while positions involving a knowledge of mechanical science should be filled by those who had made their record within the field of that science? The captain referred to is competent, no doubt, for the position to which he has been appointed, and is very possibly the best man that could have been selected for the place from among those who are eligible for it. But no mechanic, whatever his attainments, was or is eligible, which seems to us to be an absurdity. All through the connection of the government with mechanical matters such absurdities are to be found. Mechanics and engineers as such must be subordinated to officers who, in the nature of things, must know far less of mechanical matters than is known by those who make a specialty of mechanical matters, and whose record and career are entirely dependent upon their knowledge of them. We believe this is decidedly unfair to mechanics. We believe that the development of naval vessels and of all kinds of fighting machines, large and small, is due mainly if not entirely to mechanics and engineers, and that they should have the credit of it. They can secure this probably only through the establishment of a department of mechanics, which should stand upon the same footing as the other departments of the government. Other advantages would probably result from the establishment of such a department which need not be mentioned at this time, but which will suggest themselves.

A Very Necessary Precaution.

One result of the opening of the World's Fair has seemed to be the employment of a new corps of correspondents who on mechanical matters are even worse than the regular newspaper men. One of them telegraphs the following story from Chicago to his paper in New York—a paper, by the way, which pretends to give some especial attention to mechanical and engineering matters. The story relates to the manner in which the Fair was to be opened, and the event which it describes has, of course, passed in safety.

Attached to the key is a wire which runs down the side of the platform and to the valve on a four-inch pipe which supplies the steam to the great Allis engine, which will set the machinery in motion. An eight-inch steam pipe is usually employed, but Mr. Cleveland's hand is heavy. Its pressure will open the valve wide, and if the valve on the eight-inch pipe were opened its full width it would blow out the cylinder head of the boiler.

Rather than take chances on coaching the President to touch the key lightly, which in the excitement of the moment he might neglect to do, Chief Robinson of the Machinery Building substituted a four-inch pipe temporarily.

It is with a sense of relief that we reflect that the event to which this refers has passed and no catastrophe has occurred. We had feared that the weight of the President's hand might have been underestimated, and that a four-inch pipe would prove too large, in which case it is almost certain that the cylinder head of the boiler would have been unable to stand the strain.

Literary Notes.

PATENTABLE INVENTION. By Edward S. Renwick, civil and mechanical engineer, and expert in patent causes.

The author, who is a patent expert, an inventor, and a practical man, is well qualified for the task of writing on subjects relating to the law of patents for inventions. The aim of the author in publishing the book is best stated in his own words: "The diverse constructions of the law as to what constitutes invention are especially unfortunate in view of the creation of the present nine appellate courts, it being evident that unless these courts shall decide upon some common rules by which invention can be determined, and the decisions of the different courts can be harmonized, there will result the anomaly that the decisions upon the same subject in one appellate circuit will clash with those in another. What such rules are to be must be determined by the courts, who alone have authority to deal with such matters; but it seems to be fair that the views of the inventors upon the subject should be considered, and the object of the author in publishing this book has been to endeavor to present these views."

The book is divided into three parts; the first part deals with patentable invention; the second, inventions patentable by law; the third, invention patentable in a re-issue patent. Various decisions of courts relating to the above matter are cited, and references of the reports given, so that the originals may be examined by those who wish to do so.

The author has succeeded in bringing out a very valuable work, which should be in the hands of all who are in any way interested in patent laws and inventions. It is published by The Lawyers' Co-operative Publishing Co., Rochester, N. Y. Price, $2.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(223) P. A. H., Detroit, Mich., writes: Please give me the title of a good machinist's dictionary. *A.*—"Knight's American Mechanical Dictionary" may suit you.

(224) A. G. C., East St. Louis, Ill., asks: Can you favor me with a formula for proportioning friction gearing, such as is used in the mills of this country? I have made a great many inquiries among the makers and users of the same, but so far everything seems to have been made on the cut-and-try plan. *A.*—There is no occasion for proportioning friction wheels by the cut-and-try plan. You will find rules relating to this subject in Elements of Machine Design, by W. C. Unwin; also in Mechanics of Engineering and of Machinery, by J. Weisbach.

(225) H. C. S., Baltimore, Md., writes: Please define the meaning of a triple-compound condensing engine *A.*—A triple-expansion condensing engine is one in which the steam is expanded in three different stages, and after it leaves the low-pressure cylinder it is condensed. A triple-expansion engine has usually three cylinders, a high-pressure, intermediate-pressure, and low-pressure cylinder. The first stage of expansion takes place in the high-pressure cylinder; the second stage takes place in the intermediate cylinder, and the third in the low-pressure cylinder. Sometimes a triple-expansion engine has two low-pressure cylinders, in this case the third stage of expansion takes place in these two cylinders conjointly; or if the engine has two intermediate cylinders, the second stage of expansion takes place in these two cylinders. Your other questions relating to bicycles are answered in connection with similar questions sent by another correspondent, in our last issue.

(226) N. M. C., Canton, O., writes: Kindly inform me if there has ever appeared in the AMERICAN MACHINIST a rule for designing high-speed engines, something as follows: An engine to develop a certain power at a given piston speed and bore of cylinder given, using the bore of the cylinder as a basis to calculate the diameter of shaft, crank-pin, also all other parts of engine, so that by using the same rule any number of engines can be designed, all having the same uniform strength and relations. If such a formula has not appeared in your journal, where can I procure a book giving these rules, which are simple, not having too many technicalities? *A.*—We have not published such a rule for the simple reason that there is none. To design steam engines a knowledge of the strength of material is necessary. Within certain limits the crank-shaft, crank-pin and a few other parts can have a certain ratio to the diameter of the cylinder, and even in such cases good judgment and experience are required. You will need quite a number of books treating on various subjects to become familiar with and competent to design steam engines.

(227) J. H. W., Dayton, O., writes: I would like to have your opinion in regard to the economy in the transmission of power in cases like the following. We will say that it has been decided to build a new boiler shop which is to be stocked with suitable machines. There will be no line shaft, no

countershafts, and consequently no belting, but each machine will have its own steam engine. The steam is to be obtained from the heat in the furnaces, which otherwise would be wasted. The source of power will be quite near to the machines. When all had been planned a friend comes along and says: Look here, your neighbor drives his machines with electric motors, a new thing, great economy in power, you should have the same arrangement or you will not be up with the times. Now we know how to repair engines, but we know very little of repairing electric motors. Thinking that it may be possible that we are standing in our own light, we would like to have your opinion. *A.*—Since you intend to use steam generated by heat which would otherwise be wasted we do not see how you could stand in your own light by using a steam engine for each machine when economy is considered. But when cleanliness and convenience are considered the electric motors will have the advantage.

(228) J. S., Buffalo, N. Y., writes: Kindly publish the procedure of setting the eccentrics on an engine which has to run forward and backward. The engine is to be used for a paving roller. *A.*—The principles involved in setting the eccentrics for any engine in which steam is distributed by an ordinary D slide valve are the same for all. In our issue of October 24, 1885, you will find these principles plainly stated and practically applied to setting the eccentric of an engine running in one direction only. But if it is understood how to set an eccentric in this class of engine, there will be no difficulty in setting the eccentrics of an engine which has to run in either direction. In this class of engine you simply set first one eccentric to suit one direction of running, and then the other eccentric by the same methods to suit the opposite direction of running. Of course for an engine which has to run in either direction a link is generally used. A practical example of setting a valve gear with a link motion is given in our issues of April 30, May 14, 28, 1887. This refers to setting the valve gear of a locomotive, but the principles involved do not change for setting the valve gear of your engine. 2. Can you recommend a good book relating to valve motion? *A.*—"Slide-valve Gears," by F. A. Halsey, is a good book.

(229) J. R. H., Cleveland, Ohio, writes: There have been two questions asked in the shop of which I am foreman. They are: 1. Is it proper to write the decimal .750 and call it 750 thousandths? One man claims it is not proper to do so, and says it reads 75 hundredths. *A.*—It is of no use to add a cipher to the end of a decimal, although it is frequently done. The decimal .750 reads 750 thousandths, and the decimal .75 reads 75 hundredths, but both are of the same value, namely, $\frac{3}{4}$ of a unit. Although it cannot be said that it is incorrect to write .750 instead of .75, yet there is no more use of doing so than to write $\frac{30}{40}$ in place of $\frac{3}{4}$. 2. Has any pump ever lifted water 28 feet high? If so, what kind of pump was it, and where is it working? *A.*—It is possible to lift water, with a lift or suction pump, to a height of 28 feet, provided all the joints in the suction pipe are perfectly tight, and the pump is of good construction, but cases of this kind are an exception, and not the rule, because, owing to the difficulty of obtaining tight joints in the suction pipe, the height to which water can be raised with this class of pumps was gradually decreased, until 22 to 25 feet was regarded as the practical or ordinary limit of suction. If water has to be raised to a greater height, a force pump will have to be used. Pumps of both classes you will find all over the country.

(230) C. P. T., Chattanooga, Tenn., writes: I have a small steam launch, with a compound engine and a condensing pipe running along the keel of the boat, which returns the water due to condensation at a temperature of 65 to 75 degrees. Now what I want to know is: Can I, by attaching an air pump to the end of this pipe, approach anything like a vacuum? The condensing pipe is nearly 6 inches below the lowest point possible to which I can attach an air pump. *A.*—You can, provided the keel condenser has a suitable form. It is essential for satisfactory working that the delivery end of the tube should not exceed one-half the diameter of its receiving end; for, if a larger diameter be given to the delivering end, a part of the exhaust steam will pass directly to the air pump over the water of condensation in the tube. The delivering end of the tube must be small enough to remain completely filled with water for the exclusion of the steam from the pump. The steam yacht "Leila," on which experiments were made by a number of United States naval engineers, had an air pump attached to the keel condenser, the latter being considerably below the air pump. The condenser consisted of a single copper pipe, 5 inches inside diameter at the exhaust steam end, and 2 inches inside diameter at the air pump end. The results during the trials were very satisfactory. A vacuum of 26 inches in the bottom of the air pump was frequently obtained.

(231) A. D., ——, writes: In the accompanying sketch for a roof truss, Fig. 1, kindly tell me if the vertical rod at the center should be larger than the tie rod. There is no other weight to be put on the roof but slate. I would like to adopt this form of roof as it is light, gives head room and a

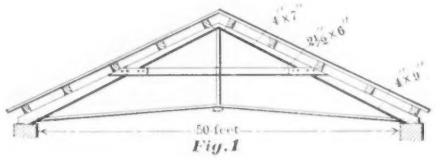


Fig. 1

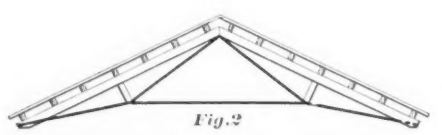
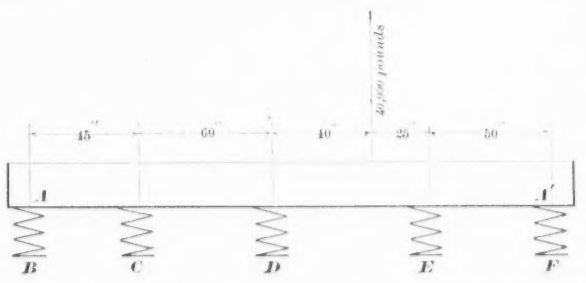


Fig. 2

clear opening for a machinery building. The span will be 50 feet and the rise 12 feet. The main rafters I intend to make 4x9 inches at the lower end and taper to 4x7 inches at top for appearance only. Do you consider it strong enough? *A.*—The center rod does not need to be as large in diameter as the tie rod. We do not see that the appearance will be improved by tapering the main rafters; in fact, in our opinion, the opposite will be the case. We do not like the general design of the truss, that shown in Fig. 2 will be stronger and more pleasing in appearance. With trusses of the latter kind placed 14 feet from center to center we should make main rafters 6x10 inches; purlins 3x8 inches. The central portion of the tie rod we should make 1¼-inch in diameter, and the two outer portions 1⅛-inch diameter, the counter brace should also be 1¼-inch in diameter. 2. What should be the dimensions of rafters, etc., for a roof 42 feet span and 10 feet rise? *A.*—If it is made of the form shown in Fig. 2, the trusses being placed 14 feet from center to center we should make the main rafters 5x10 inches; purlins, 2½x8 inches; the central portion of the tie rod 1¼-inch diameter, and the two outer portions 1⅛-inch diameter.

(232) C. D. D., Providence, R. I., writes: Please help me with the following problem: A beam is resting on five springs *B*, *C*, *D*, *E*, *F*, as per sketch, with a load of 40 000 pounds placed as shown. What will be the weight supported by each spring? Weight of beam is not to be considered. Please give method for computing these weights. *A.*—We shall assume that the springs *B*, *C* and *D* are alike, so that each will resist equal portions of the load which is supported by the beam resting on these springs; we shall also assume that the springs *E* and *F* resist equal portions of the load supported by the beam resting on them. This reduces the problem to a comparatively simple one, for here we have a beam held in equilibrium by a load of 40,000 pounds, three equal forces acting on one side of the load and two equal forces acting on the other side. The first step will be to find the distance of the center of effort of the three springs *B*, *C* and *D* from the point of application of the load, this distance we will denote by x. The distances from the load to the center of the springs *B*, *C* and *D* are respectively 145, 100 and 40 inches. Denote the force exerted by each spring by P, then the sum of the moments of the three springs will be $145\ P + 100\ P + 40\ P$; the forces P being equal we have here a system of parallel forces whose points of application are known. The resultant of these three forces is equal to their sum $3\ P$, let us denote this resultant by R.

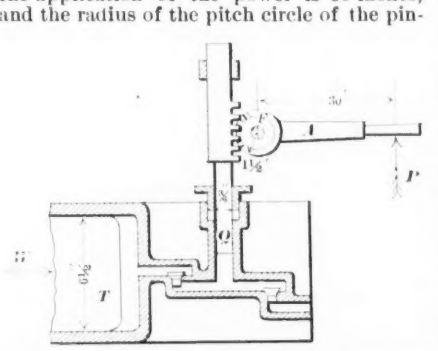


The point of application of this resultant so that it will have the same effect as the three parallel forces will be at the center of effort; that is, at a distance x from the load; hence we have

$$145\ P + 100\ P + 40\ P = R\ x.$$

If we now give a value of one pound to P we then have $145 + 100 + 40 = 3\ x$, from which we get $285 = 3\ x$; hence $x = \frac{285}{3} =$ 95 inches. The center of effort of the two springs *E* and *F* could be found in the same way, but there is no necessity for making the calculation, as it is easily seen that the distance of the center of effort from the load is 50 inches. We may now assume that the load has two points of support only, one at 95 inches from the load to the left and one at 50 inches from the load to the right. The question now arises what will be the resistance of each one of these points of support. This is found by multiplying the load by its distance from one of the supports and dividing the product by the whole distance between the two supports, the quotient will be resistance of the support opposite to the one from which the distance of load has been taken. Thus the distance from the left support to the load is 95 inches, the whole distance between the two supports is 145 inches; hence we have $\frac{95 \times 40{,}000}{145} = 26{,}206.9$ pounds for the resistance of the right support, and $40{,}000 - 26{,}206.9 = 13{,}793.1$ for the resistance of the left support. This shows us that the two springs *E* and *F* have to support 26,206.9 pounds; hence each spring will have to support a weight of $\frac{26{,}206.9}{2}$ = 13,103 45 pounds. The three springs *B*, *C* and *D* have to support 13,793.1 pounds; hence each spring will have to support a weight of $\frac{13{,}793.1}{3} = 4{,}597.7$ pounds.

(233) J. L. H., Syracuse, N. Y., writes: Kindly answer the following question: What power will be exerted by the ram *T*, 6½ inches diameter, of a hydraulic press; the pump plunger is ¾ inch diameter, the length of lever from the center of fulcrum pin to the application of the power is 30 inches, and the radius of the pitch circle of the pin-



ion is 1½ inches, the power P applied to the handle is 100 pounds? Please give formula for solving this and similar problems. *A.*—First compute the force exerted by the rack with a force P applied at the handle of the lever as shown. Let us designate the distance from the center of the fulcrum F to the application of the power by L; the radius of the pitch circle of the pinion by l; the force exerted by the rack by Q, and the applied force by P. The moments about the fulcrum are

$$Q \times l = P \times L;$$

hence

$$Q = \frac{P \times L}{l}.$$

Substituting for the symbols their numerical values we have

$$Q = \frac{100 \times 30}{1\frac{1}{2}} = 2{,}000 \text{ pounds.}$$

But the rack and plunger are in one piece; hence the force exerted by the plunger of the pump is 2,000 pounds. The statical pressure Q is transmitted with undiminished force to every corresponding area of the cross-section of the ram *T*. Let W denote the total pressure on the ram, we then have

area of plunger : area of ram : : Q : W.

The area of the ram 6½ inches diameter is 33.183 square inches, and the area of the plunger ¾ inch diameter is .44178 of a square inch; hence we have

$$.44178 : 33.183 : : 2{,}000 : W,$$

from this we get

$$\frac{33.183 \times 2{,}000}{.44178} = W = 150{,}224$$

pounds for the total pressure exerted by the ram, friction being neglected. The foregoing can be combined in one formula. Examining the given proportion we find that in order to obtain the numerical value of W we divide the area of the ram by the area of the plunger and multiply the quotient by 2,000. Now let D denote the diameter of the ram and d the diameter of the plunger, and remembering that the area of any circle is found by multiplying the square of the diameter by .7854 we have

$$\frac{D^2 \times .7854}{d^2 \times .7854} \times 2{,}000.$$

But the decimal .7854 in the first factor cancels; hence we have

$$\frac{D^2}{d^2} \times 2{,}000.$$

Now remembering that the value of 2,000 has been obtained by the formula

$$Q = \frac{P \times L}{l}, \text{ or, in short, } \frac{P \times L}{l} = 2{,}000,$$

we may combine the whole solution as follows:

$$W = \frac{D^2}{d^2} \times \frac{P \times L}{l}.$$

Substituting for the symbols their numerical values we have

$$W = \frac{(6\ 5)^2}{(.75)^2} \times \frac{100 \times 30}{1.5} = 150{,}222$$

pounds, which is practically the same result as found before. 2. Can you recommend a book treating on hydraulics that explains the solutions of problems of this kind? *A.*—You will find solutions of a problem of this kind in "Applied Mechanics," by Prof. A. Jamieson, and in many other good books treating on the elements of mechanics.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

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"Binders" for the AMERICAN MACHINIST. Two styles the "Common Sense," as heretofore sold by us and mailed to any address at $1 00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Steam and Electric Launches in China.

The following report to the Department of State will be of interest to manufacturers:

In a recent interview with the Taotai of this Circuit I pointed out to him the great advantage in the saving of time and comfort that would accrue if he adopted the modern method of traveling by the use of a steam, oil, or electric launch in his journeys about this district. I explained, to the best of my ability, the workings of the various kinds of launches, and he seemed so pleased with the idea of being able to travel with greater comfort and more speed than is now the case that he requested me to write to the United States for particulars; therefore, I have the honor to request that the Department will kindly place this before the manufacturers of launches, in order that they may tender diagrams, cuts, etc., so that I can have the matter placed before his excellency, thus enabling him to select such

launch or engine as seems most suitable for these waters. It must be remembered that this vast district is intersected by thousands of miles of canals and rivers; and, although it covers a territory of 39,500 square miles and has a population of from 25,000,000 to 35,000,000 people, there is not a single launch or boat of any kind propelled by steam, oil, or electricity, excepting a few launches that ply from Shanghai to Hangchow, the capital, 150 miles northeast of this port.

The Taotai has occasion to go to the capital frequently. He travels in a small covered boat propelled by "ya lows" (large oars), worked similarly as a whale boat is worked, *i. e.*, by sculling. The average distance traveled in a day is 100 lis, or 33⅓ miles.

A boat suitable for China would have to be built very strong, the propeller be so arranged that it could be taken up or protected in some way from the ropes that are passed around the stern of the boat while it is being pulled over the "haul over" from a river to a canal or from a lower to a higher canal. A "haul over" (over part of the bank sloped for the purpose by masonry or earthwork and covered with wet and slippery clay) forms a sluiceway. A boat to pass from a river to a canal has a rope passed around the stern, the ends of the rope being wound around a windlass on each side of the sluice. Men work the windlass on both sides until the boat has been hauled to the ridge, when it is pushed into the water. There are no locks. Sometimes a boat is dragged across a "haul over" by water buffaloes or oxen, but the first method is the common one hereabouts.

Another consideration is, that in some places the canals are only wide enough for a boat of the regulation size. This is especially so between the supports or arches of bridges. Finally, the bridges are so low that it is of the greatest importance that the roof of the cabin or cover should not be so high as to prevent the boat from passing under them.

The boats for traveling are called house boats. Foreign boats use a hull built native fashion, and in or on this hull is erected a small house, fitted with windows, berths, closets, etc. They are quite comfortable, and one can travel for weeks; in fact, it is the only way one can travel in this part of China. The boats used by the natives are not so comfortable, yet are often more expensive.

If it is possible for manufacturers to build an engine that can be placed in the boats used here, I think that there would soon be a large demand for such engines. The canals are the only roads, and all travel is, of course, by boat. The traffic carried on by boats is very large. The introduction of quicker methods of travel would be highly appreciated, especially if the Taotai sets the example, and I deem this a most auspicious time to introduce our methods into this province. * * *

For the guidance of interested parties the following description may be of some use: Length, 38 feet; breadth, 6 feet 10 inches; height from keel to rail, 3 feet; height from rail to top of house, 2 feet 9 inches.

A flat-bottom boat is, of course, preferable and one that follows the Chinese style. It has occurred to me that it may be possible that a boat could be built with a top or house, having the sides arranged in such a manner that it could be telescoped or lowered; in that case the roof could be higher than in a stationary one. One without a smokestack or with a smokestack that is easily lowered would be popular; in any case the stack must be a very short or low one. It would be well for the manufacturers to include in their estimates the cost of delivering the same by steamer or sailing vessel at Shanghai or Hongkong.

I have been discussing the benefits of small launches with the Taotai for the past two years, and now he has requested me to find out all I can for him. If he should adopt a launch for his own use, I am quite confident that it will not be long before many orders will be placed with our manufacturers. There is a splendid opening here. An immense traffic is carried on in boats, which now depends on the tide and the endurance of the "yu loose" (scullers). A company has been organized at Swatow of Chinese, who run a steam ferry (launches) a short distance up-river, and I understand they are doing a very lucrative business.

JOHN FOWLER, Consul,
United States Consulate,
Ningpo, March 10, 1893.

At a recent meeting of the Birmingham (England) Association of Mechanical Engineers, Mr. Alexander Siemens delivered a lecture on electricity as a motive power for factories. In the course of his lecture Mr. Siemens stated that in an electric locomotive recently supplied by his firm the brushes were still in use, after a run of 20,000 miles. Speaking generally, electromotors were very light in weight for the power they exerted, and did not require expensive foundations. The efficiency of transmission was, moreover, greater with electricity than with shafting.

Columbian Exposition Notes.

OPENING DAY.

At 12.15 the first day of May, by a simple motion of the hand the President of the United States started the two great engines of the power plant, and thus officially opened the World's Columbian Exposition.

Braving rain and mud, between two and three hundred thousand people entered Jackson Park to see the President of the United States, the lineal descendant of Christopher Columbus, the opening of the great Fair, and the Fair itself.

Before 8 o'clock many were waiting for the gates to open; at 9 the space in front of the Administration building where the exercises were to be held was well filled. By 10 almost every available space which commanded any view of the platform was taken possession of. The crowd extended from the Mines to the Machinery, and around the main basin clear back to the statue of Columbia.

The speakers' platform was directly in front of the middle of the Administration building, facing the main basin. Back of it rose a great tier of seats reserved for the fortunate ones having tickets. At the very back of this platform the orchestra was located.

Shortly after 11 o'clock President Cleveland, and the others high in authority, appeared. The crowd was immense by this time; it was enthusiastic as well, and gave them a royal greeting.

The ceremonies were opened by the "Columbian March and Hymn" from the orchestra; then followed a prayer, then the reading of "The Prophecy," a Columbian poem; then music again. This was followed by a short address from Director-General Davis. President Cleveland followed. The great crowd cheered him heartily. He spoke briefly, and closed the ceremonies by "pressing the button."

Immediately the big fountains began to spout, flags which had been hanging lifeless at the bottom of their poles were raised and unfurled to the breeze, and such a din arose from the cheering of the throng, the tooting of the whistles on the launches in the basin, and the ring of the great whistle chime on Machinery Hall; while above all the rest could be heard the national salute from the guns of the U. S. S. "Michigan," which lay near the shore.

The noise subsided almost as abruptly as it arose, and the crowd turned its attention to other things. Part sought the roadway which the visitors must take from the Administration building; part scattered through the grounds in all directions to see the buildings and exhibits. While another and quite a large part made a rush for Machinery Hall, to see that the engines had started all right. Indeed Machinery Hall was a sight; fully three-quarters of the engines and dynamos in the power plant were in motion.

Of course the center of attraction was the big Allis engine. This is one of the two engines started by pressing the button. The method used is quite interesting. A 10″ pipe runs from the steam header to a point under the floor at one side of the high-pressure cylinder—here it reduces and an 8″ pipe comes up through the floor, over and down into the top of the cylinder. In the 10″ pipe a 10″ valve is placed with a 10″x10″x 4″ T each side of it. To the 4″ openings a by-pass is connected which comes up through the floor just back of the engine, and has a 4″ valve in it. This valve is about four feet above the floor, its spindle is horizontal and has a sprocket wheel upon it. On a low pedestal, just to the side of the valve, rests a neatly-finished oak box with another and smaller sprocket wheel outside. These two wheels are geared together by a light brass chain. Inside the box is a strong spiral spring on the same spindle with the sprocket. This spring is wound tight and held by a catch in a ratchet wheel. When everything was ready the throttle valve on the engine was opened, and the 10″ and 4″ valves were closed.

When Mr. Cleveland pushed the button at the Administration building, the electric current drew the catch and the spring opened the valve.

The other engine started by the same current was the big Worthington pump, in the pump house—one of the pumps which supply the fountains. The by-pass in this case was 2″ diameter. The electric current opened a very small valve, which admitted steam back of a plunger, which in turn opened the 2″ valve, much the same action as in the valves in many steam pumps.

This same current also rang a large gong in Machinery Hall and another in the Pump House, which was the signal for the starting of all the other engines in the old-fashioned way. Of course, steam was turned on full for the two engines mentioned above by opening the valves, jumped by the by-passes, by hand.

None of the line-shaft engines were ready to start except the Galloway's engine in the English section, and some difficulty was encountered with that.

THE MACHINE SHOP.

Though Machinery Hall will contain exhibits of all forms of machine tools, there will be very little opportunity to illustrate the relation of such machines one to the other. Each firm will exhibit its own tools in its own space regardless of what its neighbors may have.

A machine shop on the Exposition grounds was found to be a necessity for repairing, and odd and end work, and a very favorable business arrangement has been made by which the Exposition has gained a complete machine shop, while certain manufacturers may have the best of all advertising—that of showing their machines at work.

The machine shop is a building 125x86 feet. It joins the boiler house extension on the west, and the Machinery Annex on the south, opening into the latter by wide doorways. Just inside the shop is the visitors' gallery on the same level as the annex floor, and about 6 feet above the machine shop floor.

In front of the gallery a Shaw traveling crane runs the length of the shop—an electric crane of 10 tons capacity and 41 feet span. The space beyond the crane, that is, between it and the south wall, is occupied by the shafting and the tools. The shafting is supported from the roof trusses by light wooden framing built from truss to truss. The center of the shafts is about 21 feet from the shop floor. This is higher than is general, but the feeling of "roominess" created by the high ceiling and the better light more than make up for any disadvantages introduced.

Power is derived from two electric motors, of 20 horse-power each, one at each end of the shop, and each driving its own half of the machinery. By this arrangement one-half of the shop may be shut down without affecting the other half.

While all machines will be located in positions most convenient for the performance of their work, much study has been given to the general effect, the aim being to show all machines to equal advantage. The smaller tools will be grouped, opposite the middle of the visitors' gallery; the larger ones will fill up the space at either end, between them and the walls.

In one corner of the shop is the office, in another the men's toilet room—here each man has his own locker; in a third corner is a well-equipped tool-room. Along the south wall are the benches, and a good assortment of vises. All the tools are not in the shop as yet, though the few already belted up have been doing good work in the erection of the power plant.

The machine shop is in the charge of Mr. J. M. Thomas, Superintendent, a practical machinist, who not only has charge of the operation of the shop, but has given valuable aid in the general arrangement of it. About twenty men will be kept busy at the tools.

There will undoubtedly be several machines in the shop worthy of special description, as they will possess some of the best and latest improvements in their respective lines.

Mr. F. A. Scheffler resigned his position as general superintendent of the Brush Co., of Cleveland, O., April 1st, and has accepted the position of general sales agent of the Stirling Company, manufacturers of the Stirling water tube boiler, with office at 74 Cortlandt street, New York City.

A Detroit dispatch says that the employes of the Lake Superior iron companies have been put on the eight hour a day basis, the miners promising to do as much work in eight hours as they formerly did in ten.

If a correspondent who writes us from somewhere in Wisconsin, about steam loops, will give his post-office address we will answer his question by mail.

MANUFACTURES.

W. R. Kindly, of Mt. Pleasant, N. C., will erect a cotton-mill.

The Wilson (N. C.) Cotton-mills are enlarging their buildings.

The Royersford Hosiery Co., at Royersford, Pa., will double its capacity.

The Lexington (S. C.) Manufacturing Co. will establish a batting-mill.

A cotton-mill will soon be erected by Mr. T. S. Diffey at San Marcos, Tex.

A new chair stock factory is to be erected by R. D. Filkins at Dalton, Mass.

A stock company with a capital of $50,000 will start a paper mill at Thamesville, Conn.

The Brewer Car Axle Box Co., of Chicago, has been incorporated with $5,000,000 capital.

The Overland Machinery Co., succeeds the Hendey & Meyer Engineering Co., at Denver, Col.

The Glen Manufacturing Co., of Berlin Falls, N. H., will erect a large sulphite pulp-mill.

Work upon the foundations of the paper-mill building at Fort Scott, Kan., has commenced.

A company has been organized and $15,000 stock issued to establish a cannery at Seattle, Wash.

The Charleston (S. C.) Bucket and Veneer Co. has been chartered with a capital stock $10,000.

The Conover Manufacturing Company have removed their offices to 39-41 Cortlandt street, New York.

The Washington (D. C.) Last and Shoe Company has been organized to manufacture; capital stock, $100,000.

George Game, of the Wachusett Shirt Company, of Leominster, Mass., will build at Island Pond a shirt factory.

At Maxton, N. C., Messrs. Ross & McKinnon have begun the erection of buildings for a cotton manufacturing plant.

The People's Tanning and Manufacturing Association, Cumberland, Miss., will enlarge the capacity of its tannery.

The Pittsburg and St. Louis Zinc and Lead Co., of St. Louis, Mo., has increased its capital stock from $150,000 to $200,000.

The Orangeburg (N. C.) Manufacturing Co. has been incorporated by J. G. Wanamaker to manufacture sash, doors, blinds, etc.

C. T. Nevins, the Auburn (Me.) manufacturer, is making an addition to his carriage factory. The addition is 15x35 feet and four stories.

The Uncas Paper Company has been organized at Norwich, Conn., with a capital of $50,000 in 500 shares at $100 each, 20 per cent. paid in.

The Superior Electric Company, with $800,000 capital, has been formed in Chicago, Ill., to manufacture electric motors, dynamos and machines.

The Superior-Dakota Elevator Co., of West Superior, Wis., has filed articles of association with the Secretary of State. The capital stock is $100,000.

L. Dake & Son., importers of American goods, have established a permanent exhibition of articles of American manufacture at Amsterdam, Holland.

The United States Wagon Manufacturing Co., Chicago, Ill., has been chartered. Capital, $1,000,000. Incorporators, A. J. McDuffee and Jno. A. McDonald.

The Electrolized Rawhide Leather Company, of Chicago, Ill., has incorporated. Capital stock, $1,000,000. Incorporators, Jonas H. Wheeler and W. D. Dunning.

The Union Iron and Foundry Company, of St. Louis, Mo., have filed articles with the Secretary of State, to increase their capital stock from $25,000 to $50,000.

The E. J. Hickey Company has been organized at Portland, Me., to manufacture paper, with $500,000 capital. President is E. J. Hickey, of Hyde Park, Mass.

The Perfection Horse Shoe Company, with capital $150,000, has been incorporated in Chicago, Ill., to manufacture horse shoes, etc. Incorporators, Wm. Greiner and A. Jackson.

The New Doty Manufacturing Company, Janesville, Wis., has issued a very complete illustrated catalogue of punching and shearing machinery, bending rolls, bolt headers, etc.

The Northern Manufacturing Co., of Kasoag, N. Y., has been incorporated to manufacture furniture with capital of $10,000. C. J. Williams, J. A. Frost and others are connected.

The Can Labeling Machine Company, with capital, $50,000, has organized at Elgin, Ill., to manufacture can labeling machines. Incorporators, Wm. H. Leach and H. N. Moseley.

The latest catalogue of Armington & Sims Engine Company, Providence, R. I., is as usual finely printed and illustrated with cuts of high-speed engines both horizontal and vertical.

The Standard Shovel Company has formed in New York with capital, $15,000, for the manufacture of shovels. Incorporators, Peter H. Corr and E. Garnier See, of New York City.

The Mansfield (O.) Earth Excavator Company, with $18,000 capital, has formed for the manufacture of a new earth excavator. Incorporators, Willis M Sturges and Thos. B. Keating.

The J. B. Plummer Co. has been capitalized at Portland, Me., to manufacture baskets, brooms, etc The capital stock is $100,000, and the officers are: President, C. A. Hight; treasurer, E. K. Milliken.

The Geneva (N. Y.) Philosophical Instrumental Company has been formed, with capital, $30,000, for the manufacture of scientific instruments. Incorporators, Wm. Smith and Oswald J. C. Rose, Geneva, N. Y.

The Security Cash Register Company, with $20,000 capital, has been incorporated at Hanover, Pa., for the manufacture of registers and other patented articles. Incorporators, J. H. Bittinger and Vincent O. Bold.

The J. B. Plummer Co., has been organized at Portland, Me., for manufacturing brooms, tubs and woodenware, with $100,000 capital. The president is C. A. Hight, of Portland; treasurer, E. K. Mulliken, of Cumberland.

The Hoppes Mfg. Co., Springfield, Ohio, has issued a catalogue of live steam feed water purifiers and exhaust steam feed-water heaters. The catalogue is illustrated, and attention is called to recent improvements in their purifiers and heaters.

The Hartford Axle Co. has been organized at Norfolk, Conn., with a capital of $15,000, in 600 shares of $25 each, 20 per cent. paid in. The incorporators are forty-two residents of Norfolk, Southington, Torrington, Winsted, Simsbury, New Britain, Shelton, Sioux City, Ia., and Hartford.

The Woolen Company's plant at Arkwright, R. I., will make an addition to the main building of the dyeing and finishing house, 128x60 feet, two stories. The bleaching house will also be enlarged 60x20 feet, and an addition, 42x14 feet, will be made to the boiler-room. The buildings will be brick and stone. As soon as completed they will be filled with machinery and will furnish employment for about 50 additional hands.

There is water-works agitation at Orbisonia, Pa.; Yellow Creek, Ill.; Bangor, Me.; Hartington, Neb.; Harrisburg, Pa.; Oakley, Kan.; West Springfield, Mass.; South Antrim, N. H.; Middletown, Md.; Fowler, Ind.; Reading, Pa.; Minneapolis, Minn.; Quincy, Mass.; Cassadaga, N. Y.; Danville, Ky.; Peterborough, Ont.; Belmont, Mass; Cochranton, Pa; Silverton, Wash.; Indianapolis, Ind.; Pittsburgh, Pa.; Lancaster, Mass.

The Warder, Bushnell & Glessner Co., of Springfield, Ohio, will erect a gray iron foundry 500x80 feet with a capacity for 50 tons of castings per day. Mr. Chas. A. Bauer, M. E., who is at the head of the mechanical department of the business has recently been looking into the matter of electric transmission of power to isolated points about the plant. This firm is now building 150 mowers, and 100 self-binding reapers per day.

The Phœnix Iron Works Co., Meadville, Pa., have just sold the Saginaw (Mich.) Power Co., two 300 horse-power "Dick & Church" tandem compound engines. These engines will each be coupled direct to a 200 K. W. generator. They have also sold the Wyandotte & Detroit River Railway another compound engine of 150 horse-power capacity, and have closed a contract for eight horizontal tubular boilers for the street railway plant at Allentown, Pa.

Brown & Sharpe Mfg. Co., Providence, R. I., have issued a new edition of their popular catalogue, a previous edition of which is so likely to be found in the office of manufacturers, in the tool chest or cupboard of mechanics, and in the rooms of engineers. The new catalogue—the blue book, as it is familiarly called by mechanics—contains 58 more pages than the preceding issue, 306 pages in all, consisting of illustrations of machines, mechanics' small tools, etc. The catalogue is sent free on application. It should be obtained, and the old one destroyed, as it has been thoroughly revised and rewritten.

We have received the following: "Messrs. O Chan. Wells and Charles Albert Coutan have retired from the management of the New York house of The Crosby Steam Gauge and Valve Co., to engage in the manufacturing of standard steam vacuum and all other gauges and kindred goods, which department is added to the business of this company. We have been appointed sales agents for Messrs. J E. Lonergan & Co., manufacturers of pop safety, water relief and Snifter valves, etc. Mr. William A. Locke has associated himself with us. With full appreciation of the favors shown us, we place our services at your command. Yours truly, Wells & Coutan Co., Limited, 29-31 Gold St., New York."

Machinists' Supplies and Iron.

NEW YORK, May 6, 1893.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $14.50 to $15.25; No. 2, $13.50 to $14.25; Gray Forge, $12.75 to $13 50. Southern brands of good quality are obtainable at $14.25 to $14.50 for No. 1 Foundry; $13 to $14 for No. 2 and $12 to $13 for Gray Forge.

Antimony—The market is steady. We quote L. X., 10¼c. to 10½c.; Cookson's, 10½c. to 10¾c.; Hallett's, 10c. to 10⅛c., and U. S. French Star, 10½c.

Copper—There is no important change in the market. Second hands offer Lake Copper at 11c. to 11¼c. without business. Casting Copper is held at 10¾c. to 10⅞c.

Lead—The market is dull Supplies from second-hands are still obtainable at 4 05c., but the demand continues low.

Lard Oil—Prime City is quoted at 84c. to 85c.

Spelter—The market is dull, and quotations remain about the same, 4.45c. to 4 50c., but the inside price is exceptional.

Tin—There is scarcely any change in the market. Spot can be had at 20.55c. to 20.60c.; June at 20.60c. and July at 20.75c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Salesmen on commission, to push a special line of mach'y. "Kirk," care of AM MACH.

Wanted—1st-class mach. shop foreman. Give age, salary expected, and refs. M., AM. MACHINIST.

Die maker 12 yrs' exp. on blank'g & combination, wants pos. The East pref'd. Box 116, AM. MACH.

Wanted—Foremanship; engines, pumps or general jobbing. Indicator, AMERICAN MACHINIST.

Wanted—Six 1st-class machinists. Apply Toledo, Ann Arbor & Nth. Mich. Ry., Owosso, Mich.

Mechanical draftsman, graduate, shop and office experience, wants position. Box 115, AM. MACH.

Mech. eng., grad. of a European Polytech'l school, exp., wishes pos. as draftsman. I. R., AM MACH.

Wanted A1 pattern maker, who has had exp in making blower patterns. Box 113, AM. MACH.

Wanted—Position as foreman by man well up on tool and jig work and piece-work system. Address Ohio, care AMERICAN MACHINIST.

Wanted—Steady position by a first-class pattern maker. Would prefer to take charge of small pattern shop. F. P. H., AMERICAN MACHINIST.

Wanted—By a practical mechanic and a good manager of men, a change; strictly temperate and reliable; age 33, best of ref. Esq., AM. MACH.

Wanted—A 1st-class foreman for machine shop. One experienced in saw mill work. The McArdle & Sinclair Mfg. Co., New Orleans, La.

A technical graduate, with shop and about 7 years' drawing room experience, wants situation. Address S., Box 110, care AMERICAN MACHINIST.

Wanted—An experienced and competent man as sup't in forging department of a carriage hardware manufactory. Manufacturer, Box 58, AM. MACH.

Wanted—Eight or ten first-class machinists, bench hands, etc.; steady employment; state wages and experience. Address Box 102, AM. MACHINIST.

Wanted—Six planer, ten lathe and ten vise hands; must be thorough practical machinists. S. K. White, 75 North Clinton street, Chicago, Ill.

Successful superintendent of foundry and machine works wants to change location; can bring superior automatic engine and other paying machines and work. Expert, AMERICAN MACHINIST.

Wanted—A young man, graduate of College or Manual Training School, who has had a little shop and drafting office experience. Address Box 99, AMERICAN MACHINIST.

Foreman Wanted—Who can rub men the right way to increase production and do good work. One familiar with high-grade engines desired. H. G., P. O. Box 1001, N. Y.

Wanted—Position as chief draftsman, by a mech. draftsman, who has had 10 years' practical exp. on hydraulic machinery, Corliss and triple expansion engines and special mach'y. Box 114, AM. MACH.

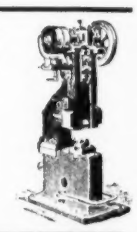
Foreman blacksmith desires change position; thoroughly posted in most modern methods and machinery; knows how to handle men; sober, and a hustler. Address J. G., AMERICAN MACHINIST.

Foreman pattern maker, age 32, 10 years' experience on machine tool, gearing and special machinery, and some exp. in drafting, desires situation; best of references. Box 107, AM. MACHINIST.

(*Continued on page 12.*)

HACKNEY HAMMERS

Meet all requirements more fully and satisfactorily than any other of its competitors.
INVESTIGATION IS NOT COSTLY.
INVESTIGATION IS CONVINCING.
WRITE FOR CATALOGUE TO
THE HACKNEY HAMMER CO.
20 Johnson St., CLEVELAND, O.



Bradley Hammers.

If you plate, draw, square, taper, swage, collar, spindle, or do any manner of die forging in iron or steel, a BRADLEY HAMMER will soon pay for itself, by what it will save over any other similar tool. Send for circulars.
BRADLEY & COMPANY, SYRACUSE, N. Y.

Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.

Steam Engine Design
By JAY M. WHITHAM,
8vo Cloth, $6.00.
JOHN WILEY & SONS, New York.

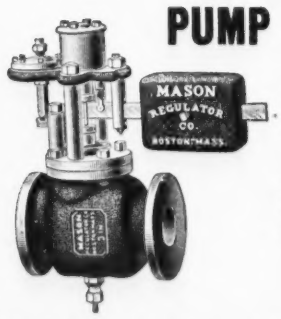
CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK

ENGINEERS
and gentlemen having business with Steam Users, wanted as agents to represent a prominent manufacturer. Write for circular and terms. Mention this paper.
Address P. O. Box 137, Philadelphia, Pa.

STEEL BALLS

¼" to 2" in stock; sizes to 4" to order.
Circular and Prices on Application.
Grant Anti-Friction Ball Co.
Fitchburg, Mass., U. S. A.

A NEW STYLE PUMP PRESSURE REGULATOR.



This is a Pressure Regulator, especially designed to meet the requirement of Steam Pumps in Elevator service.
The lever bearings are hung on hardened steel knife edges, which makes the Regulator in its working as sensitive as a pair of scales.
MASON REGULATOR CO.,
BOSTON, MASS., U. S. A.

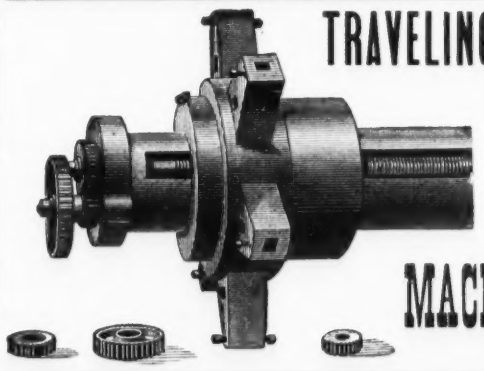
ASSIGNEES SALE.

UNIVERSAL RADIAL DRILL CO., CINCINNATI, OHIO.

Sealed Bids will be received until 10 A. M., May 25th, 1893, by the undersigned for the entire plant and stock on hand (raw, in process and finished machines) of THE UNIVERSAL RADIAL DRILL CO., of Cincinnati, Ohio, including Drawings, Patterns, Jigs, Fixtures, etc., and valuable leasehold. Works open for inspection. Schedule on file at my office, **No. 75 West 3d Street, Cincinnati, Ohio.**

A. B. CHAMPION, Assignee.

TRAVELING HEAD BORING BARS.



6¼, 8, 10, 12, 14 in. diameter.
ANY LENGTH.
MADE BY
BETTS MACHINE CO.
MACHINE TOOL BUILDERS,
WILMINGTON, DEL.

H. W. JOHNS'
ASBESTOS
SECTIONAL PIPE COVERINGS.

Non-Conducting Coverings for Steam and Hot Water Pipes, Boilers, etc.
ASBESTOS BOILER COVERINGS.
H. W. JOHNS MANUFACTURING COMPANY,
H. W. Johns' Asbestos Millboard, Sheathings, Building Felts, Fire-Proof Paints, Liquid Paints, Asbestos Roofing, Etc.
87 MAIDEN LANE, N. Y. JERSEY CITY, CHICAGO, PHILADELPHIA, BOSTON, ATLANTA, LONDON.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Draftsman Wanted—To grow into responsible place in drafting room. Mod price to start. Worcester tech. graduate preferred. Address, giving exp., and wages expected. Box 93, Am. Machinist.

Wanted—Two good molders for dry and green sand work machinery, castings, etc. To save time in writing we wish to know what exp. you have had; age and wages expected. Box 200, Am. Mach.

Wanted—Position as foreman in iron foundry; experience twenty years; age 40; holding similar position in a first-class jobbing shop at present; references furnished. Address Box 104, Am. Mach

Wanted—Pos as manager or superintendent by a hustler, capable of handling men and business, who wishes to change from present position and locality. Address Hustle, Box 112, Am. Mach.

Wanted—A good handy young man for doing odd repair jobs, and general work about a New York machinery store. Address, stating experience, and salary expected, Box 109, Am. Mach.

Machine shop foreman desires to change. Experience covers shafting and general machinery, new and repair work around rolling-mills, including care of and repairs to engines from 10 to 1,500 horse-power. Box 108, American Machinist.

Wanted—A situation by one with over 30 years' experience in foundry and machine shop, more than half the time in charge of both departments, best of references. Address P. O. Box 358, Foxboro, Mass.

Position wanted with progressive concern by an educated mechanic who has large exp. designing and building machine tools, engines and gen'l machinery; successful manager of shop & men; pos'n as designer or sup't preferred. Box 89, Am. Mach.

Wanted—Position as superintendent or foreman by a young man, at present erecting large engines for a well-known firm Extensive exp. First class machinist, engineer and electrician. Cornell graduate. Desires to locate permanently with some reliable firm Pusher, American Machinist.

A comp. and exp'd young mech. eng., holding responsible pos. with 1st-class eng'g firm, seeks change. Thor. on all details of multi-cylinder Corliss eng., direct connected eng. for steam dynamos, hoisting eng., heavy transmission & cable mach'y, machine tools, jigs, for systematic mfg. Box 111, Am. Mach.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Working drawings, etc. J. D. Riggs, Toledo, O.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

For Sale—Half interest in a well-established machine shop and foundry in a city in Western New York. Address Works, American Machinist.

FOR SALE.

The entire outfit of two well equipped Machine Shops, which we have just purchased. The lot comprises:

DRILL PRESSES,
ENGINE AND HAND LATHES,
PLANERS, SHAPERS,
PLAIN AND UNIVERSAL MILLERS,
CUTTER, SURFACE AND UNIVERSAL GRINDING MACHINES,
SCREW MACHINES,
TAPPING AND CENTERING MACHINES,
POWER PRESSES,
GEAR CUTTERS,
SQUARING SHEARS,
GRINDSTONES,
FORGES AND ANVILS.

All can be seen in our warerooms. Write for photographs, description and prices of tools wanted.

THE GARVIN MACHINE CO.,
Laight and Canal Streets. New York.

SECOND-HAND AND NEW MACHINERY

Planers.	62 in x 22 ft.	Planers.	25 in. x 5 ft.
"	42 in. x 16 ft.	"	24 in. x 5 & 6 ft.
"	36 in x 12 ft.	"	24 in. x 4 ft.
"	31 in. x 8 ft.	"	22 in. x 5 ft
"	26 in. x 7 ft.	"	20 in. x 4 ft.

80 in. x 18 ft. Engine Lathe Geared Face Plate.
60 in. x 45 ft. Double Engine Lathe.
52 in. x 35 ft. Engine Lathe Horizontal Boring Machine, one end
30 in. x 28 ft. Pond Machine Tool Co Shafting Lathe.
36 in. x 16 ft Engine Lathe.
33 in. x 22 ft. " "
32 in. x 12, 14, 16, 18 ft. Bed. New Engine Lathe.
28 in. x 22 ft. Engine Lathe cheap.

25 in. x 12, 16, 20 and 24 ft. Bed.	New	do	do
21 in. x 10, 12 ft.	Bed.	do	do	do
20 in. x 5, 6, 8 & 12 ft.	do	2d Hand	do	do
18 in. x 6, 7 & 8 ft.	do	New &	do	do
17 in. x 8 ft.	do	do	do	do
16 in. x 6 & 8 ft.	do	do	do	do
15 in. x 6 & 8 ft.	do	do	do	do
14 in. x 6 ft.	do	do	do	do

Car Axle Lathe, Bement. | Driving Wheel Lathe 88 in.
15, 16, 18, 25 in. Crank Shapers. | Wheel Quartering Mach.,
20 24, 26 & 30 in. Geared Shapers, | Double right and left hand.
20, 22 24, 28, 30 & 36 in Drills. | No. 0 Turret Lathe,
Bolt Cutters. | Am. Tool and Mach. Co.,
8 and 13 in. Stroke Slotters. | 24 in. Swing, 8 ft. Bed.
Lot of Lincoln Pattern Millers and No. 1 P. & W. Millers.
2 Spindle Drills. Garvin. No. 75 Bliss Press Geared.
Gear Molding Machine. Stamping Press, Bridgeport.
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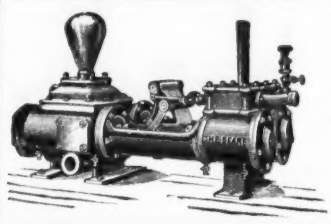

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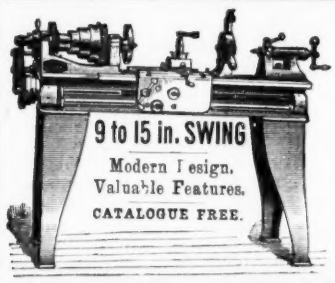

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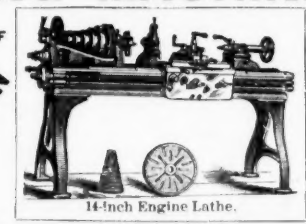

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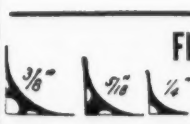

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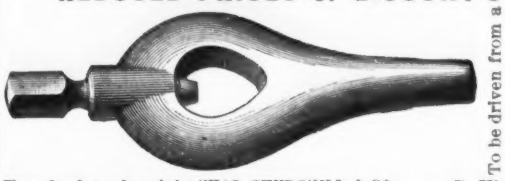

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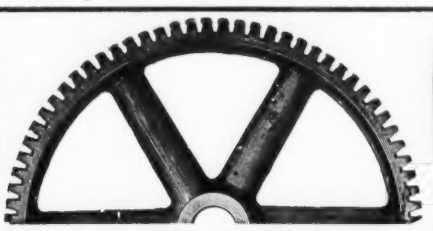

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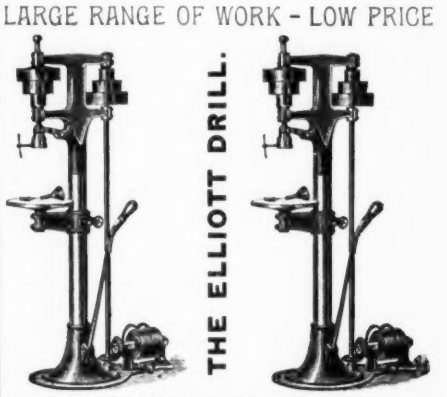

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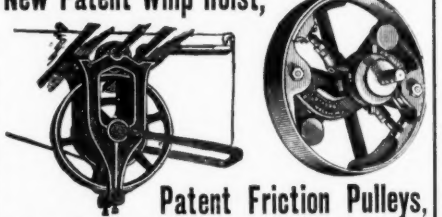

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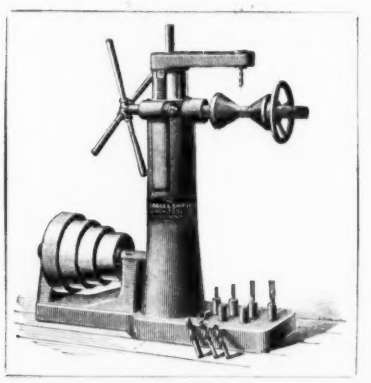

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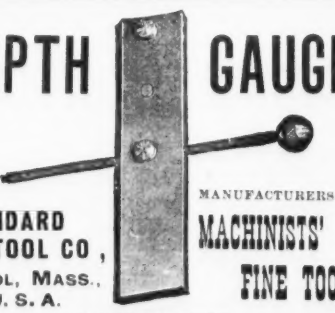

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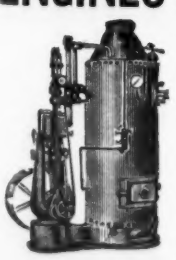

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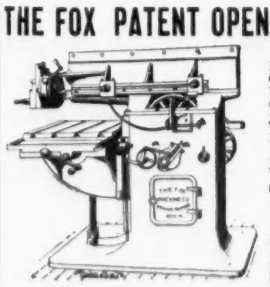

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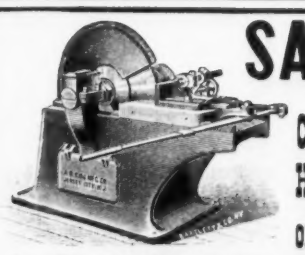

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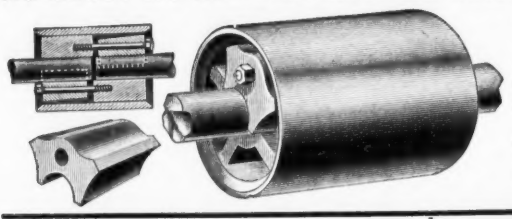

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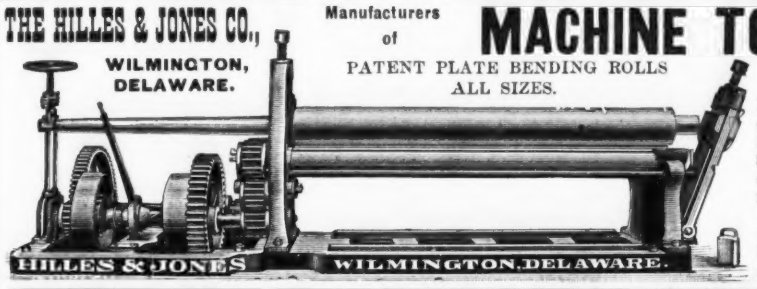

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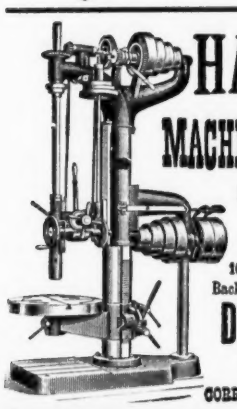

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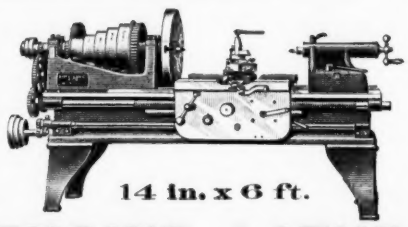

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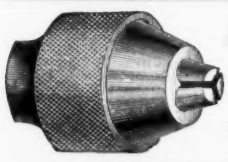

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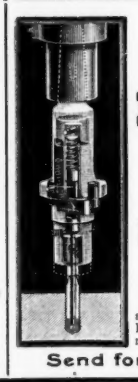

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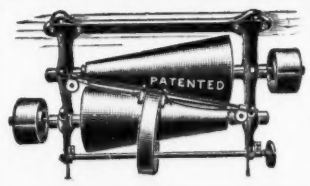

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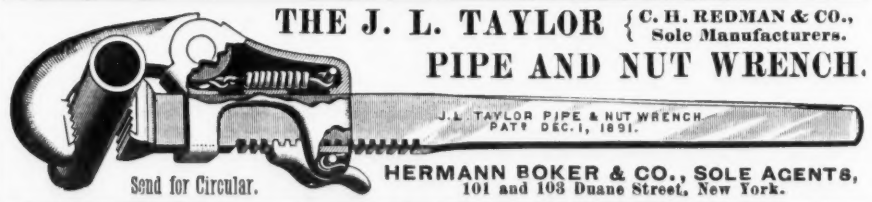

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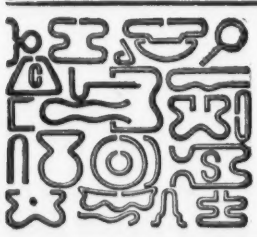

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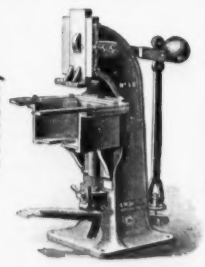

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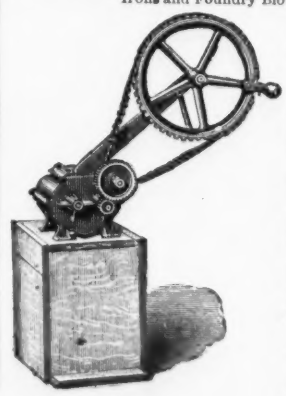

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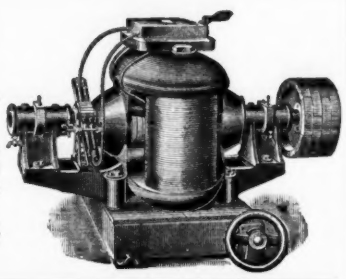

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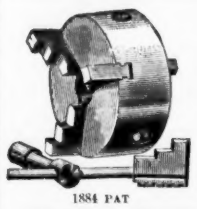
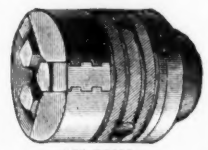

1884 PAT

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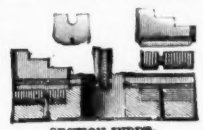
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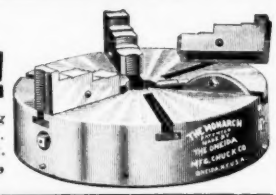

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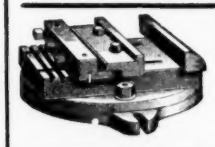
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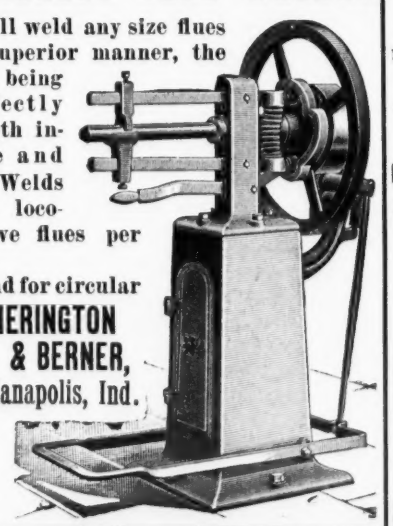

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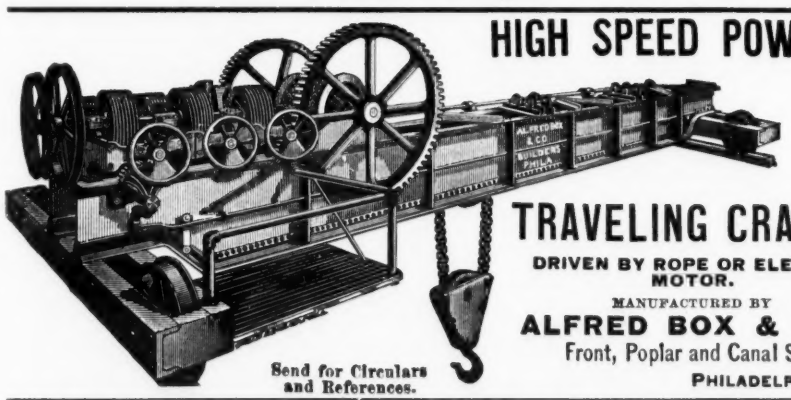
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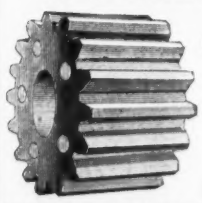
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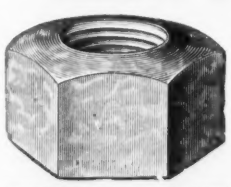
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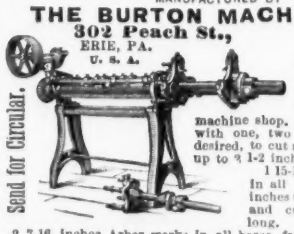
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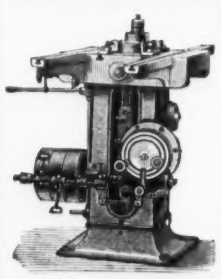
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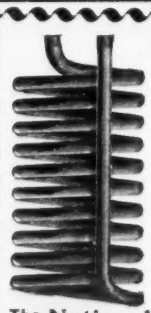
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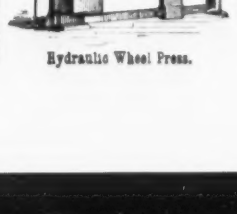
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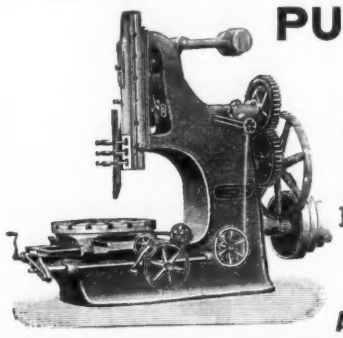

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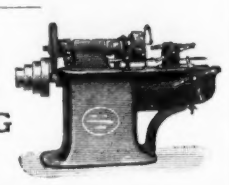

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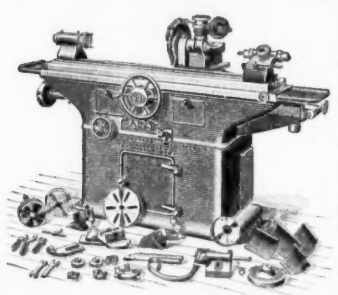

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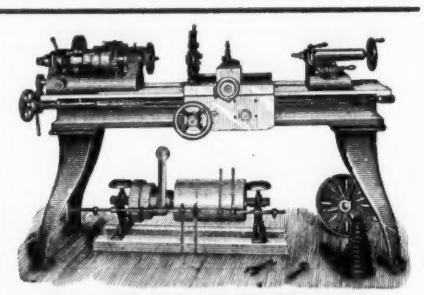

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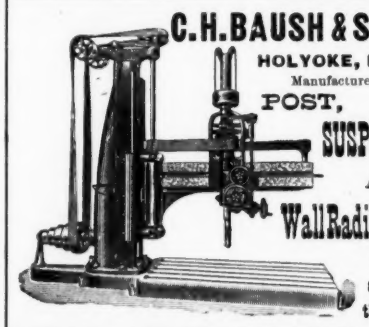

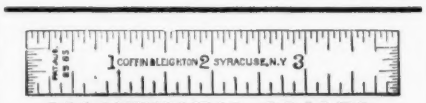

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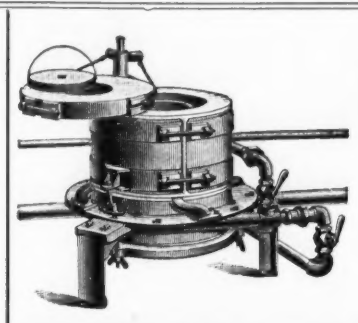

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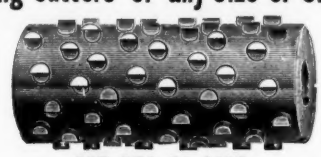

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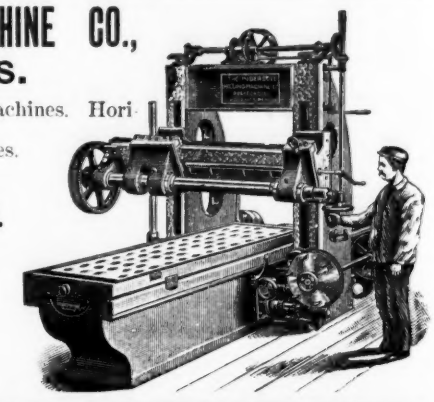

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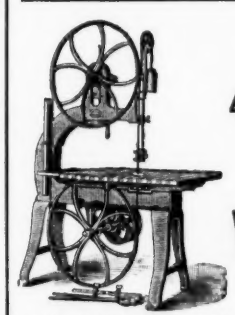

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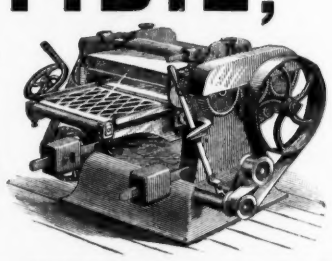

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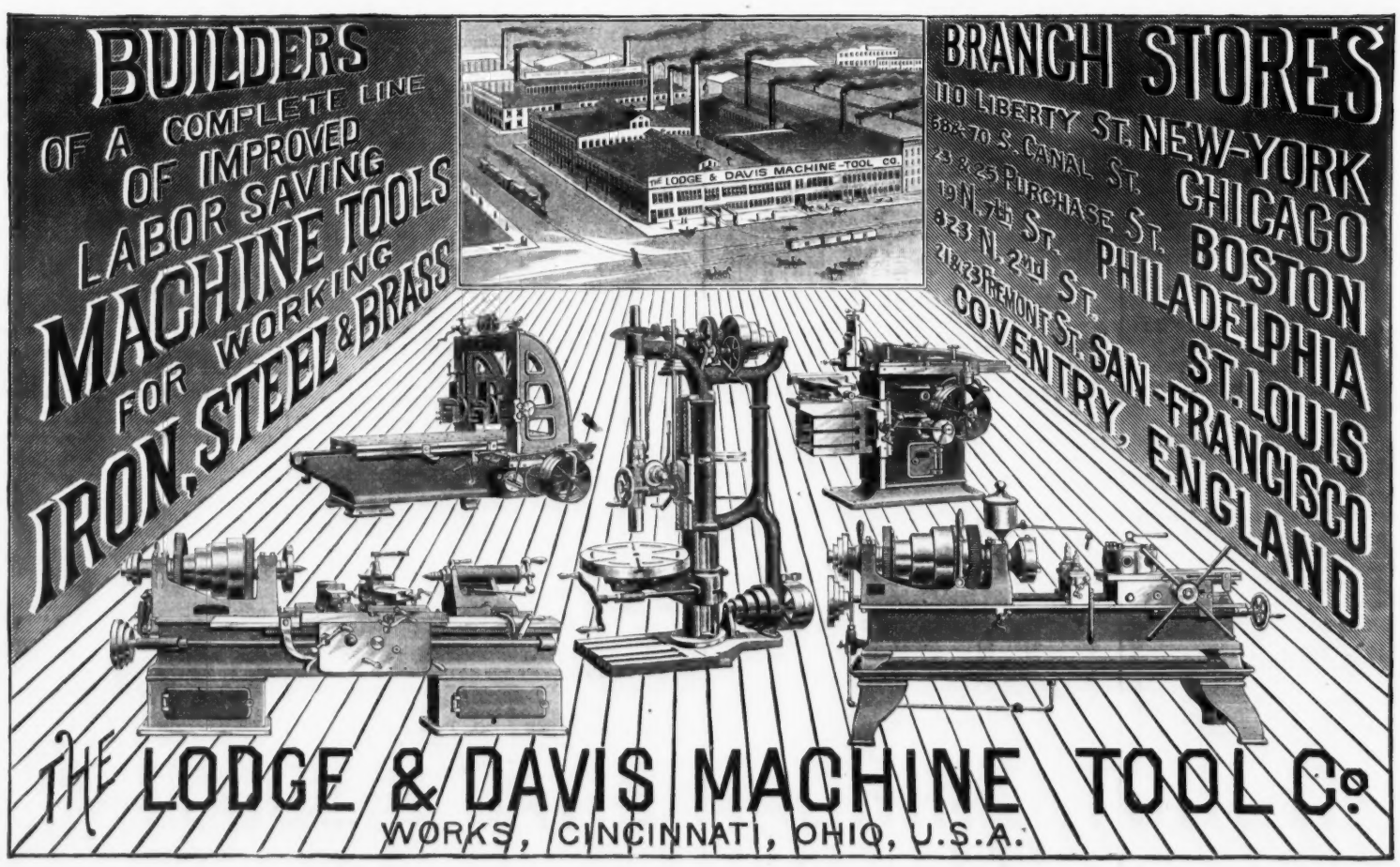

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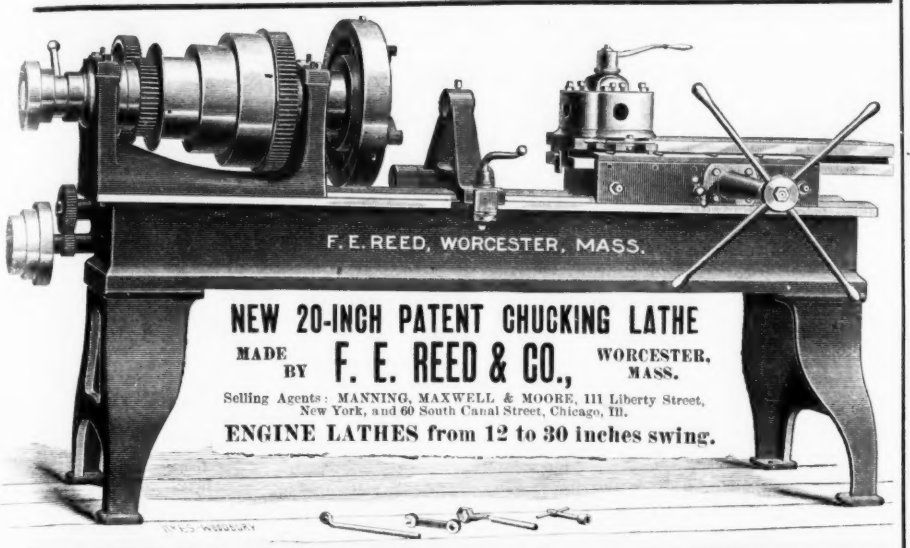

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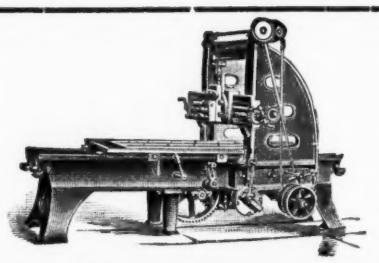

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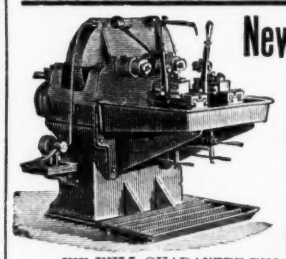

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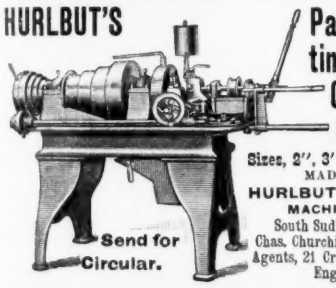

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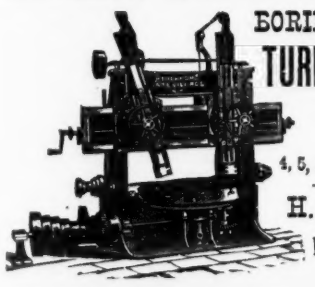

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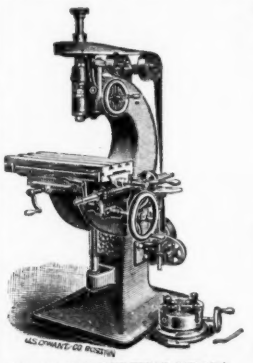

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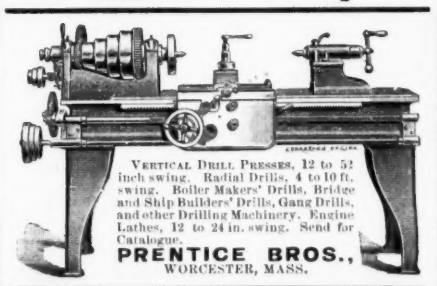

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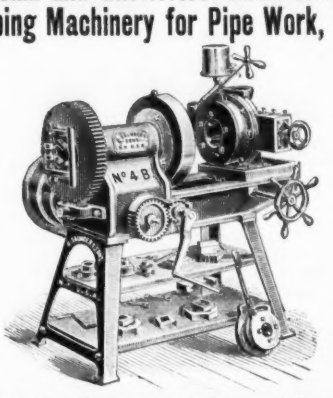

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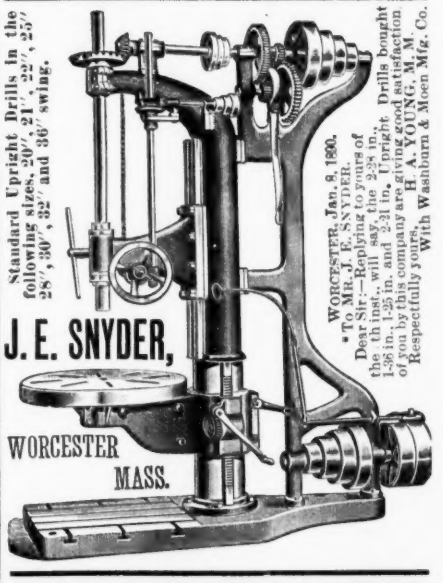

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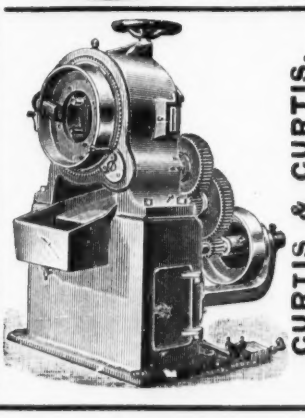

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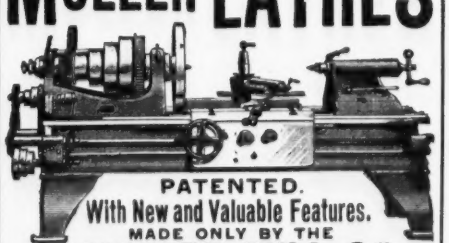

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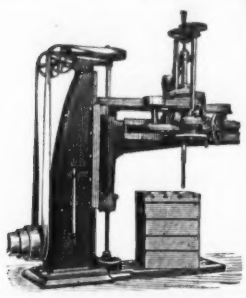

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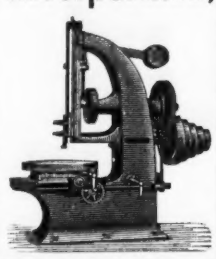

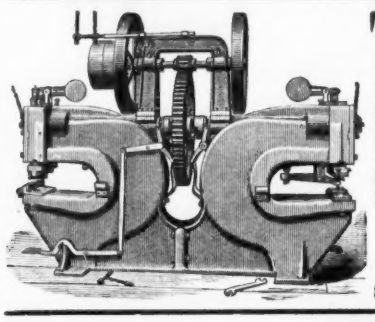

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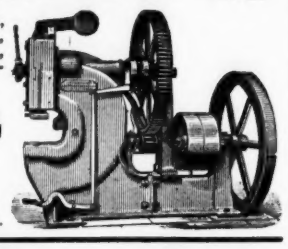

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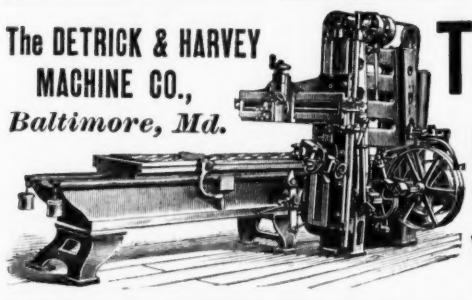

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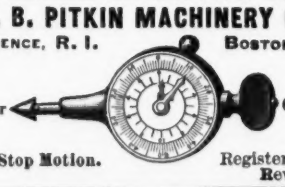

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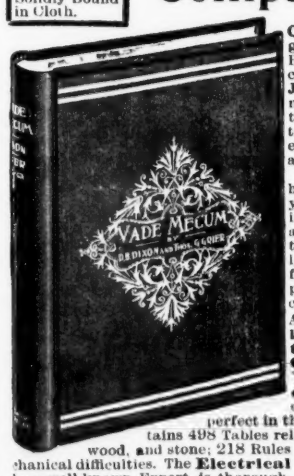

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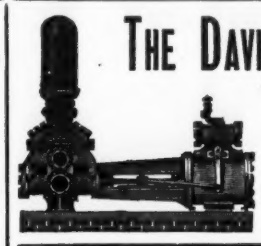

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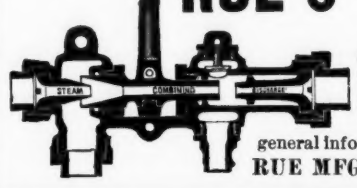

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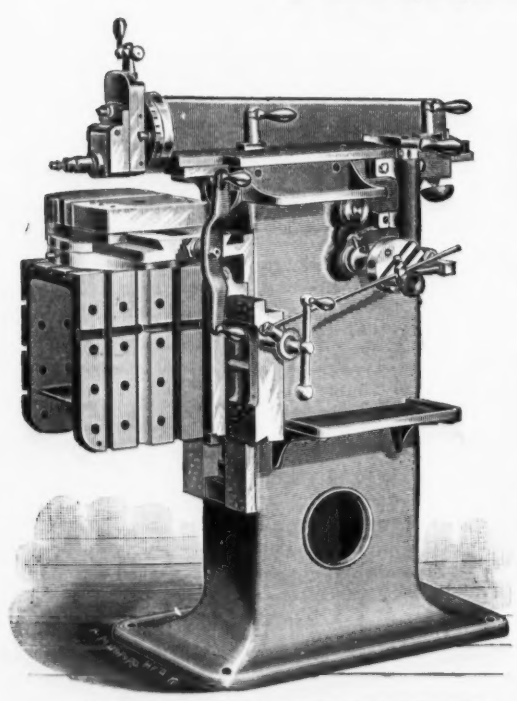

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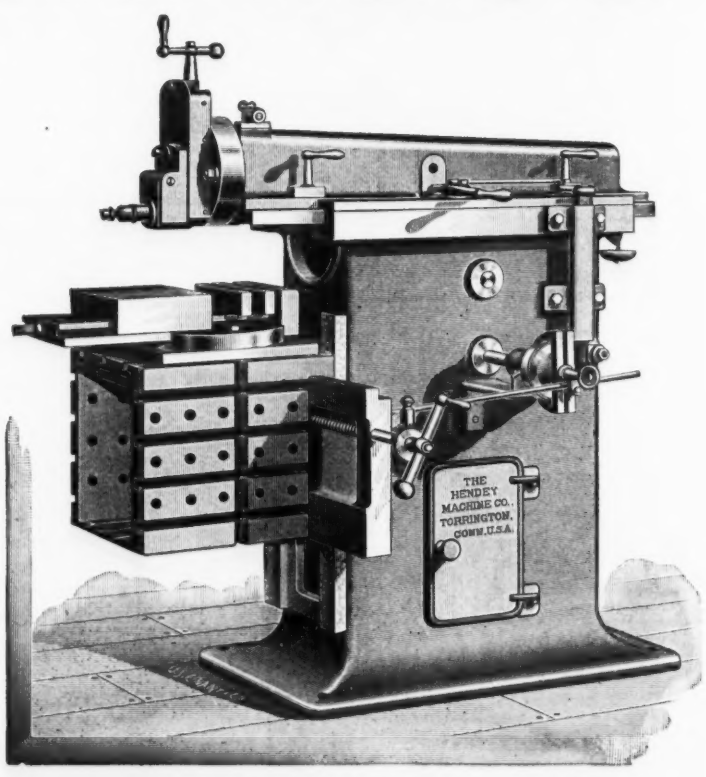

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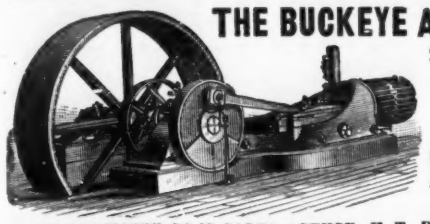

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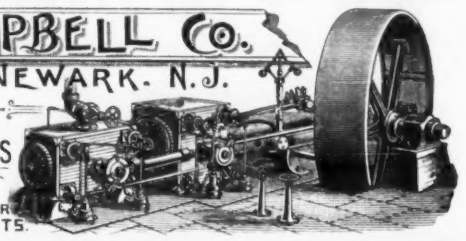

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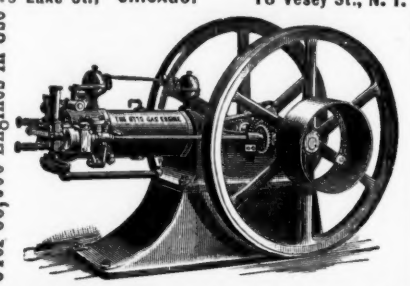

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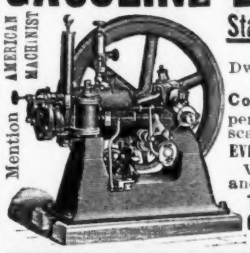

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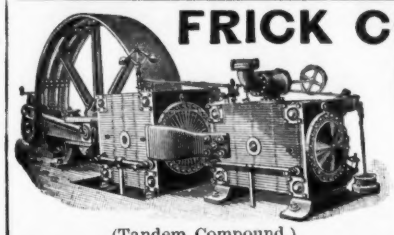

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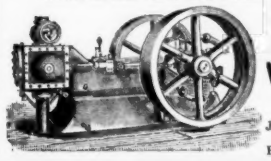

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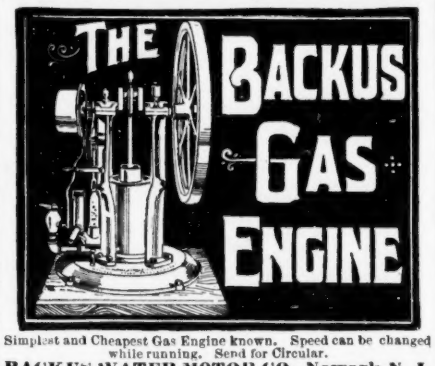

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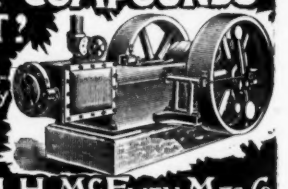

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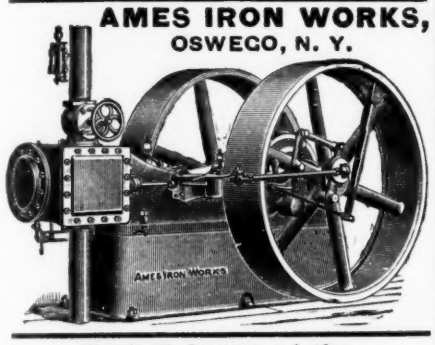

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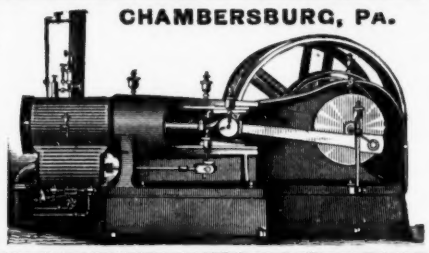

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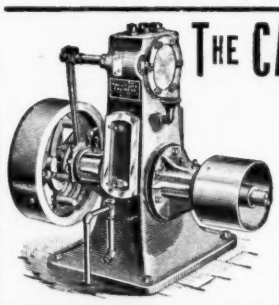

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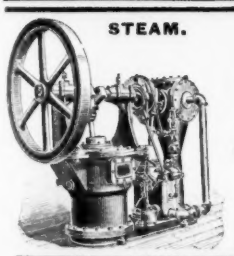

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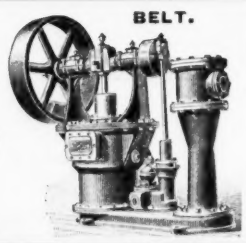

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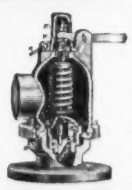

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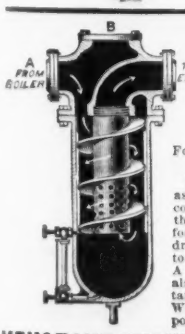

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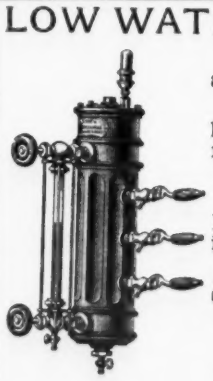

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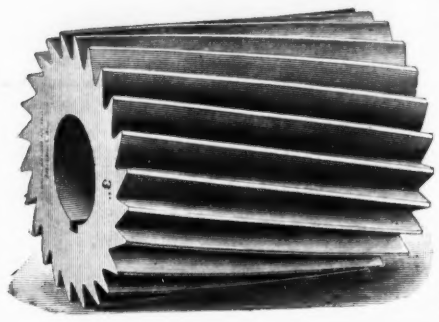

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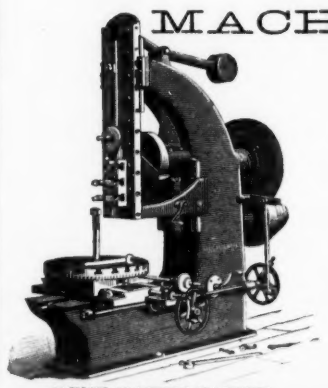

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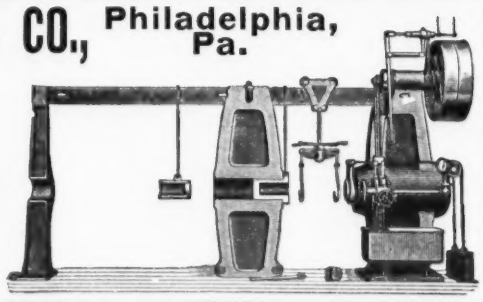

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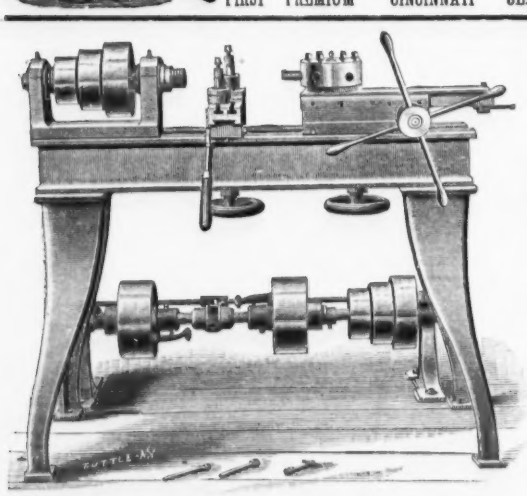

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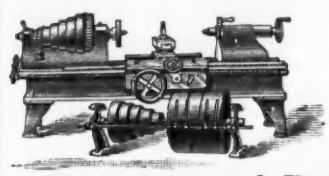

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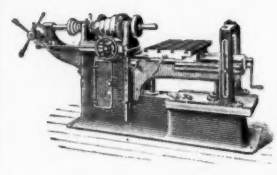

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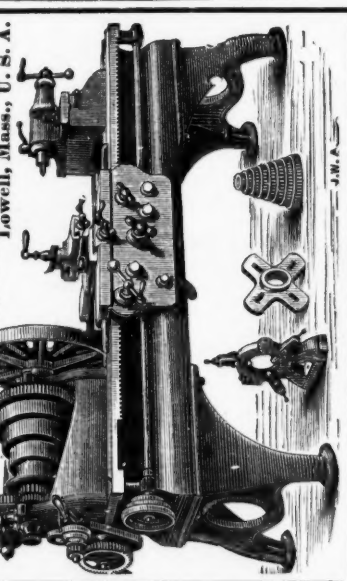

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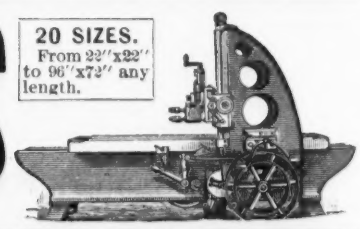

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